REVISION OF THE CARIBBEAN GENUS *GINORIA* (LYTHRACEAE), INCLUDING *HAITIA* FROM HISPANIOLA[1]

Shirley A. Graham[2]

ABSTRACT

The Caribbean genus *Ginoria* Jacq. (Lythraceae) is revised for the first time since a monograph was completed in 1903. Studies of the wood anatomy, vegetative and floral morphology, pollen and seed morphology, and chromosome numbers are summarized for *Ginoria* and the putatively closely related genera *Crenea* Aubl., *Haitia* Urb., *Lawsonia* L., and *Tetrataxis* Hook. f. Flowers of *G. lanceolata* O. C. Schmidt are described for the first time. *Ginoria* is minimally paraphyletic and possibly polyphyletic. Either *Ammannia* L./*Nesaea* Comm. ex Kunth or *Lawsonia* is sister to *Ginoria* based on ITS data. Phylogenetic analysis based on morphology finds *Ginoria* monophyletic only when *Haitia* is included in the genus. Phylogenetic analysis based on ITS sequences produced a single tree in which *G. jimenezii* Alain, a rare species from the Dominican Republic, is sister to the rest of the genus and *Tetrataxis* is nested within *Ginoria*. The positions of *Haitia* and *Crenea* remain to be tested by molecular data. *Haitia* is placed in synonymy of *Ginoria* based on the strength of the morphological evidence. Further taxonomic changes are deferred until more complete gene sampling among the putatively related genera is possible. Thirteen species of *Ginoria* are recognized: one from Mexico, six from Cuba, five from Hispaniola, and one from Puerto Rico and the Virgin Islands. The taxonomic treatment includes a key to the species, taxonomic descriptions, illustrations, and distribution maps. *Ginoria* sect. *Discospermum* Koehne is typified by *G. curvispina* Koehne. Three new combinations, *G. buchii* (Urb.) S. A. Graham, *G. pulchra* (Ekman & O. C. Schmidt) S. A. Graham, and *G. americana* Jacq. var. *spinosa* (Griseb.) S. A. Graham, are made. Two species are brought into synonymy: *G. spinosa* Griseb. and *G. davisii* M. C. Johnst. Evolution of selected characters and biogeography of the genus are briefly examined in a phylogenetic context. The endemic nature and rarity of the majority of species make them highly vunerable to extinction.

Key words: Caribbean, Cuba, *Ginoria*, *Haitia*, Hispaniola, IUCN Red List, Lythraceae.

Ginoria Jacq. (Fig. 1) is a small genus of the Lythraceae with up to 17 species recognized in the Greater Antilles and Mexico (Fig. 2). Most species are exclusive to Cuba or Hispaniola, but one extends the range in the Caribbean to southern Mexico and another to the Virgin Islands. The genus consists of small shrubs to trees with attractive rose- or white-petaled, campanulate flowers produced on short axillary shoots and septicidally dehiscent, 3- to 6-locular capsules filled with many minute, fragile, narrowly elongated, nonwinged seeds. *Ginoria* lacks a uniquely defining character and is closely similar in floral and seed morphology to three other genera of the Lythraceae: *Haitia* Urb., a ditypic genus from Hispaniola; the rare monotypic *Tetrataxis* Hook. f. from the Indian Ocean island of Mauritius (Graham & Lorence, 1978); and *Crenea* Aubl., a ditypic genus of rhizomatous shrubs from coastal northern South America (Lourteig, 1986). Although the species of *Ginoria* are conspicuous in flower, nearly all are poorly collected, more than half are endangered or critically endangered, and most, in the absence of fully comparative species descriptions, are poorly known taxonomically. The monograph of the genus (Koehne, 1882, 1903) includes just seven of the 14 species recognized in most floristic accounts today. Howard's (1975: 378) comment that "few monographers have considered at one time all of the species of a genus for the pan-Caribbean area" is relevant to the present taxonomy of *Ginoria*.

An initial morphologically based phylogenetic assessment of relationships among *Crenea*, *Ginoria*, *Haitia*, and *Tetrataxis* (Graham, 2002) included in a symposium on the historical biogeography of Caribbean endemics (Fritsch & McDowell, 2003) suggested that *Ginoria* was monophyletic only if the two

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[2] Missouri Botanical Garden, P.O. Box 299, St. Louis, Missouri 63166-0299, U.S.A. shirley.graham@mobot.org.

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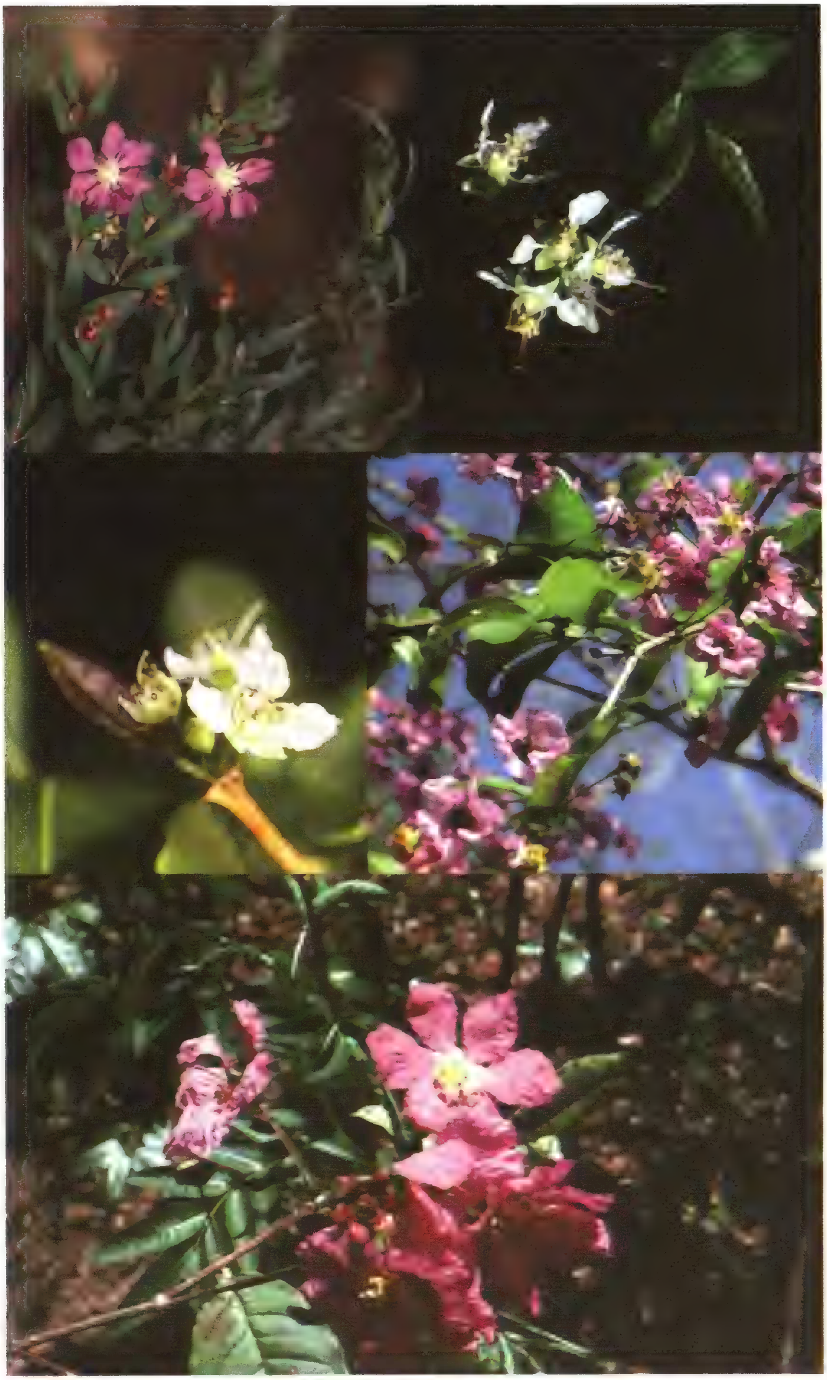

Figure 1. Top row: left, *Ginoria americana*; right, *G. nudiflora*. Middle row: left, *G. rohrii*; right, *G. ginorioides*. Bottom row: *G. buchii*. Photos, top and middle rows by S. Graham; bottom row by H. Liogier.

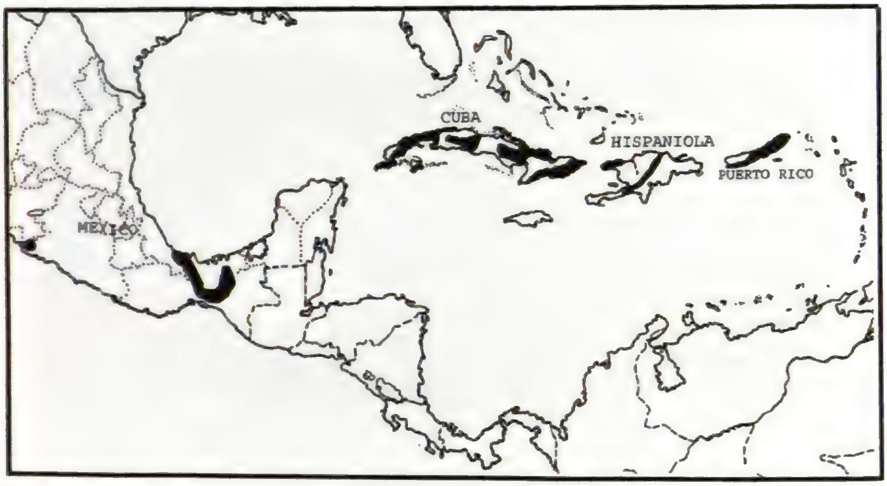

Figure 2. Distribution of the genus *Ginoria*, shown in black. Note *G. nudiflora* in western Michoacán, Mexico (black dot at left margin). The easternmost extension of the genus comprises Puerto Rico and the Virgin Islands.

species of *Haitia* were included in the genus. Overall support for the tree was weak and analyses were inadequate to determine the sister to *Ginoria*. A recent family-level phylogenetic investigation using data from the nuclear ITS region included one exemplar of *Ginoria*. The study found a sister relationship to *Tetrataxis* and clade membership with *Ammannia* L./*Nesaea* Comm. ex Kunth and *Lawsonia* L. (Graham et al., 2005). The present study revisits the relationships of *Ginoria* to its putative relatives *Haitia*, *Tetrataxis*, and *Crenea* through more extensive morphological/anatomical comparisons and by additional phylogenetic analyses of ITS sequences for six species of *Ginoria*. A revised taxonomy of *Ginoria* is presented with new keys, distribution maps, and illustrations of the species.

TAXONOMIC HISTORY

Ginoria was established in 1760 by Nicolaus Jacquin, who described *G. americana* Jacq. based on his Cuban collections. He named the genus after his benefactor and friend, the Marchese Carlos Ginori, successful founder in 1735 of the highly regarded Ginori fine porcelain factory near Florence, Italy, a company that remains in operation today as Richard-Ginori Porcelain. In 1792, the genus *Antherylium* Rohr & Vahl was described from St. Croix by J. P. B. Rohr and was accompanied in the same publication by M. Vahl's species diagnosis of *A. rohrii* Vahl, illustrated as *A. rohni*. More than half a century later, in 1866, the rich collections of Charles Wright from Cuba led the German botanist August Grisebach to describe *G. glabra* Griseb., *G. spinosa* Griseb., and *Diplusodon ginorioides* Griseb. (*G. ginorioides* (Griseb.) Britton). In 1880, William Hemsley added *Antherylium nudiflorum* Hemsl. from Oaxaca, Mexico. When Emil Koehne monographed *Ginoria* (1882) as part of his expansive work on the Lythraceae, he placed *Antherylium* in synonymy of *Ginoria*, added *G. curvispina* Koehne, and erected two subgenera for the seven species he recognized. His treatment of *Ginoria* remained unchanged in a monograph of the Lythraceae (Koehne, 1903) except for division of subgenus *Ginoria* (subg. *Euginoria* Koehne) into sections *Ginoria* (sect. *Prismatospermum* Koehne) and *Discospermum* Koehne (Appendix 1).

From 1912 to 1927, the explorations of Erik Ekman and Nathaniel Britton in Cuba and Hispaniola added seven species to *Ginoria*, which were described by Britton and Wilson at The New York Botanical Garden and by the Berlin botanists Ignatz Urban and Otto Schmidt. Since 1927, three more species have been described, bringing the total species to 17, more than twice the number recognized in the 1903 monograph. Nine species were recognized in Cuba by León and Alain (1953, reprinted 1974), all endemic to the island.

In 1919, Urban erected the genus *Haitia*, based on *H. buchii* Urb. He considered *Haitia* distinct from *Ginoria* by possession of a double calyx, in reference to the prominent epicalyx that encircles the exterior of the floral cup at the base of the sepals, and by the 6-locular ovary, as opposed to the 3- or 4-locular ovary considered typical of *Ginoria*. A second species, *H. pulchra* Ekman & O. C. Schmidt, was described by Schmidt in 1927 who, at the same time, described *G. callosa* O. C. Schmidt with a 3- to 5-locular ovary. *Haitia* has been unquestionably accepted in floristic accounts of Hispaniola as distinct from *Ginoria* since its inception (Urban, 1920; Moscoso, 1943; Liogier, 1986). Koehne (1903) classified *Ginoria* and *Tetrataxis* together as the only members of the unnamed series III in his tribe Nesaeeae subtribe Nesaeinae Koehne. *Crenea* represented series I in the same subtribe.

Materials and Methods for Systematic Observations

Data were gathered by examination of living specimens in the field in Cuba and Mexico; from greenhouse-grown specimens obtained through the Cienfuegos Botanical Garden in Cuba, Fairchild Tropical Garden in Miami, Florida, and Dr. George Proctor; and from study of exsiccatae (A, AJBC, CHAPA, CM, ENCB, G, GH, GOET, F, FF, FTG, HAC, HACC, HAJB, HCZ, HIPC, HJSS, HPVC, IPTH, JBSD, JE, K, LL, MEXU, MNHNC, MO, NY, S, TEX, UPRRP, US). Citations of herbaria follow *Index Herbariorum* (Holmgren et al., 1990) and are updated online at <http://sweetgum.nybg.org/ih/>. The following abbreviations from the list immediately above are for Cuban herbaria not listed in the *Index*: FF, Herbarium, National Enterprise for the Protection of Flora and Fauna, Villa Clara, Cuba; HCZ, Herbario de la Ciénaga de Zapata, Matanzas; HJSS, El Jardín Botánico de Sancti Spíritus; IPTH, El Jardín Botánico de Las Tunas; and MNHNC, Herbario del Museo Nacional de Historia Natural, Habana. In the citations of specimens examined, collectors' names are limited to the family name unless confusion would result; the first initials are provided for all names in the Index to Exsiccatae at the end of the study (Appendix 2).

Flower buds from field and greenhouse-grown plants for chromosome counts were fixed in 3 ethanol:1 glacial acetic acid, transferred to 70% alcohol for storage at 40°F, hydrolyzed 10–15 min. in 1N HCl at 60°C, and stained in acetocarmine. Counts were made by using a Zeiss light microscope (Carl Zeiss, Oberkochen, Germany) with phase contrast and 100× oil objective lens. Pollen samples were processed by the standard acetolysis method of Erdtman (1960). Pollen and seed coat morphology were observed with SEM after sputter-coating acetolyzed pollen and untreated seeds with gold-palladium. Materials and methods used in molecular and morphological cladistic analysis of *Ginoria* are detailed in the section on phylogeny.

Morphology and Anatomy

HABIT

Species of *Ginoria* range in habit from low suffruticose perennials to tall trees. *Ginoria americana*, a suffruticose perennial, has the smallest habit, attaining 1.5 m or less in height. *Ginoria nudiflora* (Hemsl.) Koehne can reach 40 m in the subdeciduous forests of Chiapas but is typically up to 33 m tall (Miranda, 1952), and *G. jimenezii* Alain is described as 12–15 m in height (Liogier, 1968). The rest of the species are erect or sprawling shrubs of ca. 2 m to small trees reaching ca. 7–8 m depending on local growing conditions and age. Most have a xeromorphic aspect with thick, shining, coriaceous leaves and are deciduous or semi-deciduous. The branching pattern in the genus is frequently irregular by abortion of terminal vegetative buds and the subsequent development of branches from subterminal axillary buds. Stems of the current season are slightly 4-angled to narrowly 4-winged and often red-tinged. They become increasingly terete and gray-brown with age. Internodes are often shorter than the subtending leaves and may become very short toward the tips of the branches. All species are deciduous during the dry season except *G. americana*, which grows rooted in streams or rivers or along their margins and retains leaves throughout the year. The two species of *Haitia* have the same small perennial shrub habit and frequently have abortive buds as in *Ginoria*. In related genera, *Tetrataxis* is a small tree to 12 m and *Crenea* is a rhizomatous, suffruticose perennial with winged or 4-angled stems; both have normally developed terminal buds.

WOOD ANATOMY

The wood anatomy of *Ginoria* has been investigated with *G. americana*, *G. arborea* Britton, *G. ginorioides*, *G. koehneana* Urb., *Tetrataxis*, and *Crenea* (Graham & Lorence, 1978; Baas & Zweypfenning, 1979) and for *Haitia pulchra* (Baas, 1986). The genera possess the two major wood anatomical features that characterize the order Myrtales to which Lythraceae belong, i.e., vestures in bordered pits of secondary xylem and internal phloem derived from bicollateral stems (van Vliet & Baas, 1984). They also display numerous plesiomorphic lythracean wood anatomical characters, including diffuse vessels with simple perforations, scanty paratracheal parenchyma, and heterogeneous rays. *Ginoria* shares with *Capuronia* Lourteig, *Galpinia* N. E. Br., *Lawsonia*, *Lourtella* S. A. Graham, Baas & Tobe, *Pehria* Sprague, and *Punica* L. the following anatomically derived features: chambered crystalliferous fibers, heterogeneous type II rays, and abundant septate fibers (Fig. 3A, B). Baas (1986) found the anatomy of *H. pulchra* to be identical to that of *Tetrataxis* and different from *Ginoria* by the absence of chambered crystalliferous fibers and presence of heterogeneous type I rays. However, in one specimen

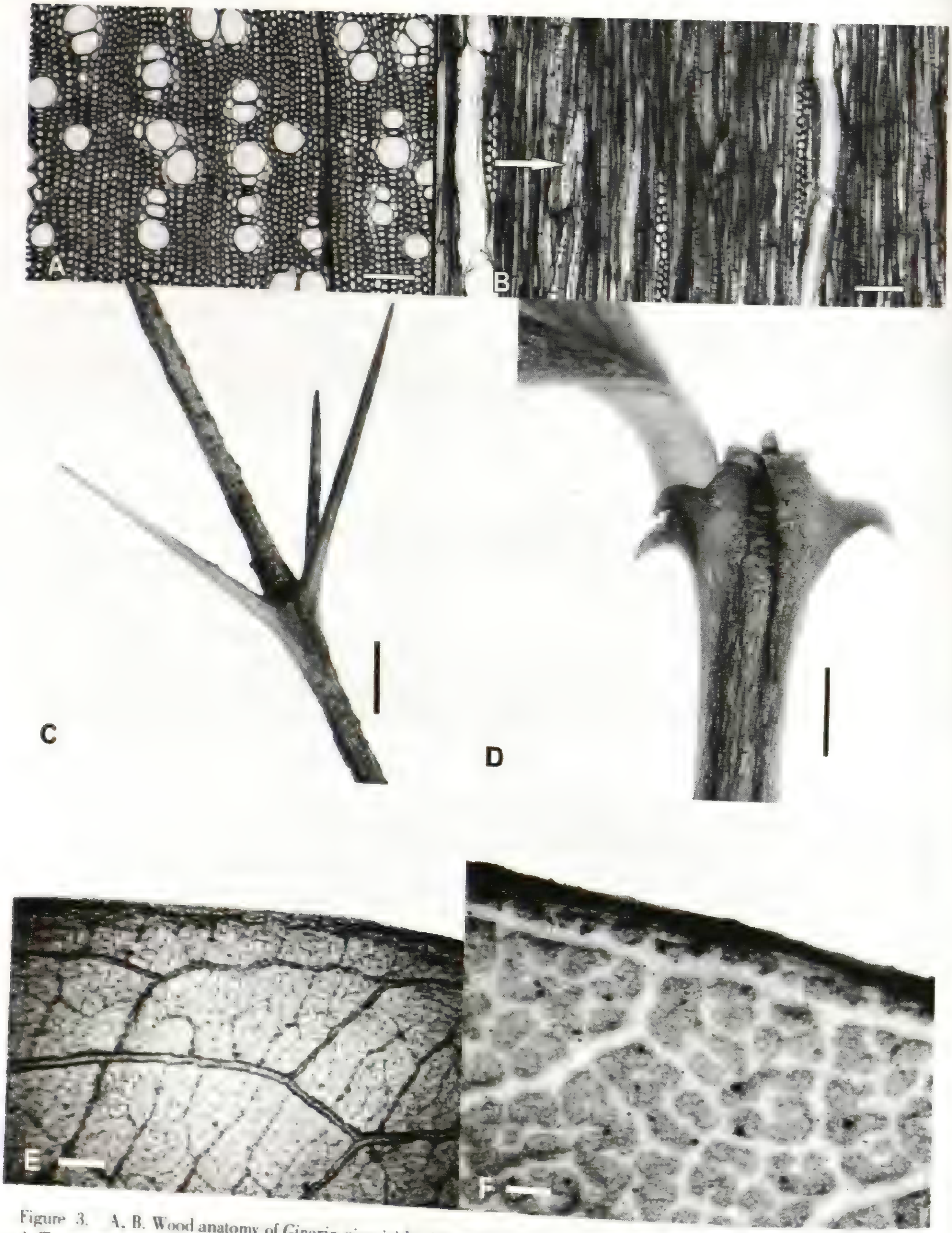

Figure 3. A, B. Wood anatomy of *Ginoria ginorioides*. Photos from preparation by Baas and Zweypfenning (*SJRW 19998*). —A. Transverse section of secondary xylem illustrating diffuse vessels and scanty paratracheal parenchyma typical of *Ginoria*. —B. Tangential section, with large vessels visible at left and right of photograph, heterogeneous type II rays, and chambered crystalliferous fibers (arrow). C, D. Spines. —C. Erect slender spines of *G. americana* var. *spinosa* (*Graham 1135*, MO). —D. Curved stout spines of *G. koehneana* (*Graham 1142*, MO). E, F. Leaf venation. —E. *G. rohrii* (*Proctor 39535*, MO). —F. *G. callosa* (*Ekman 4619*, MO). Scale bars: A, B = 100 µm; C–E = 2 mm; F = 1 mm.

of *G. americana* studied by Baas, crystalliferous fibers were absent and he indicated that a more extensive survey might well produce overlapping anatomical ranges among the genera. Wood anatomy in the more herbaceous *Crenea* differs extensively from the others, having a juvenilistic appearance with juvenilistic rays, no crystalliferous fibers, few septate fibers, and no dark vessel contents. Because anatomical specializations throughout the Lythraceae show extensive parallel development (Baas & Zweypfenning, 1979; Baas, 1986), and because the full extent of anatomical diversity in *Ginoria* is unknown, no wood anatomical characters are used to assess phylogenetic relationships in this study.

NODES AND LEAVES

Characteristic of all *Ginoria* and *Haitia* are prominent, buttressed stem nodes on which leaf scars are oriented at a 45°–90° angle to the stem. Nodes are not conspicuously buttressed on mature stems of *Crenea* but can be conspicuous on young winged stems. Sturdy spines form at the nodes in half of the species of *Ginoria*. The nodes of *G. americana* var. *spinosa* (Griseb.) S. A. Graham (Fig. 3C), *G. arborea*, *G. curvispina*, *G. lanceolata* O. C. Schmidt, and *G. rohrii* (Vahl) Koehne are consistently armed by two to four erect or curved spines as a result of the extension and induration of the free ends of the winged stem tissue. In *G. koehneana*, robust spines are characteristically present (Fig. 3D), but spineless plants from the western part of the range have been found. *Ginoria americana* var. *americana* generally is spineless, but close examination shows that most specimens have various degrees of spine development, from mere nubs to fully formed stout spines. The spines of *G. americana* var. *spinosa* are exceptionally long, slender, and erect, unlike others of the genus. The orientation of spines can vary slightly on an individual plant from recurved to horizontal or ascending, but there is a typical orientation in each species. *Haitia*, *Tetrataxis*, and *Crenea* are spineless.

Leaves in *Ginoria* and its relatives are decussate, mostly sessile or subsessile, entire-margined, ovate to elliptic or lanceolate, and range from thickly membranous to coriaceous. Venation is brochidodromous with a strong intramarginal secondary vein. Typically, there is blade tissue present between the intramarginal vein and the margin (Fig. 3E, F), but in *G. americana* var. *spinosa*, *G. curvispina*, *G. koehneana*, and *G. lanceolata* the tissue is absent and the intramarginal vein forms a cartilaginous margin. In *G. glabra* and *G. americana* var. *americana*, the intramarginal vein of smaller distal leaves infrequently merges distally with the margin. Secondary veins are shallowly to sharply ascending and range from three to six on each side of the midvein (*H. pulchra*) to eight to 20 per side in larger-leaved species (*G. ginorioides*, *G. nudiflora*, and *H. buchii*). Tertiary venation is obscure to visible (Fig. 3E) except in *G. callosa* (Fig. 3F), *G. glabra*, and *H. pulchra*, in which secondary and tertiary veins are exceptionally thickened, pale yellow, and the tertiary veins form conspicuous intercostal areolae. Tertiary veins in *G. koehneana* are also dense and thick but not yellow.

TRICHOMES

All species of *Ginoria*, *Haitia*, *Tetrataxis*, and *Crenea* are glabrous on all parts with the partial exception of *G. americana*, the stems of which can be lightly puberulent with minute, dark, unicellular trichomes.

INFLORESCENCES

Inflorescences in *Ginoria*, *Haitia*, *Tetrataxis*, and *Crenea* terminate in a vegetative bud (polytelic sensu Weberling, 1988; blastotelic sensu Briggs & Johnson, 1979) as do 26 of the 32 genera in the Lythraceae (Graham et al., 2005). The polytelic inflorescences are basically racemes, i.e., simple inflorescences in which the primary axis bears lateral flowers. Flowering is acropetal. The formation of flowering shoots among the species is exceptionally diverse due to incomplete differentiation between the flowering and vegetative branching systems (Koehne, 1884; Weberling, 1988) and the extent to which flowering lateral branches develop. Flowering lateral branches ("inflorescences" in the traditional sense) in *Ginoria* emerge commonly, but not consistently, at the beginning of a new season from the axillary buds on the vegetative shoot of the previous season before new leaves and stem are produced. These short racemose shoots are brachyblasts (Weberling, 1988). The first flowers opening on the brachyblasts are protected by dry-season scale leaves (cataphylls). As the brachyblast grows, the flowering zone may convert to a primarily vegetative zone that bears single flowers at a few of its most basal nodes. Foliaceous leaves appear at later nodes of the brachyblasts, resembling the leaves of the main vegetative stem but smaller. As a new season's brachyblasts are initiated, the vegetative long shoot (main stem) growth of the new season also begins and very often produces single flowers in the axils of the foliaceous leaves. Most flowers, however, form on brachyblasts. In the typical pattern for the genus, flowers arise: (1) on newly formed brachyblasts from buds of the previous season; (2) on brachyblasts emerging from buds in axils of stem leaves of the current season; and (3) directly as single flowers from buds in axils of stem leaves of the current season.

Brachyblasts may elongate through several internodes, as in *Ginoria curvispina*, forming racemes (botrya sensu Weberling, 1988). If the internodes are highly condensed, as in *G. ginorioides*, *G. nudiflora*, and *G. rohrii*, the leaves of the brachyblast are mere scales and the flowering shoot is umbelliform with both single flowers and condensed branches bearing two or more flowers arising in the same axil. Brachyblasts in *G. ginorioides* are typically 5- to 12-flowered and form a showy, loose umbel. In *G. rohrii*, brachyblasts are 2- to 8-flowered and form an even looser subumbelliform inflorescence. *Ginoria nudiflora* is notably multiflowered with eight to 20 flowers per umbel-like shoot. In *G. americana*, flowers are mostly solitary or two on a brachyblast in the axils of the vegetative long shoot; well-developed racemes are uncommon. Other species of *Ginoria*, *Haitia*, *Tetrataxis*, and *Crenea* are variously 1- to 3(to 12)-flowered on short brachyblasts. The degree of shoot development and number of flowers produced vary continuously among the species of *Ginoria* to the extent that it is not possible to use differences in inflorescence development in phylogenetic reconstruction.

Weberling (1988) suggests that the incomplete differentiation of the flowering short shoot or brachyblast and the vegetative long shoot in *Ginoria* represents an evolutionary stage leading toward the type of fully differentiated system seen in *Lagerstroemia* L. In *Lagerstroemia*, flower formation is restricted to the brachyblasts and the long vegetative shoots are entirely vegetative. *Lagerstroemia*, however, has a monotelic (anthotelic sensu Briggs & Johnson, 1979) inflorescence, whereas *Ginoria* is polytelic, so a direct evolutionary comparison between inflorescences in *Ginoria* and *Lagerstroemia* is not possible.

Timing of flowering versus leaf formation appears to be somewhat flexible in *Ginoria*. Most species begin flowering prior to or simultaneously with the expansion of the new season's leaves, mainly in February or March, and continue to flower until June or July. Exceptions may be *G. callosa*, *G. glabra*, *G. jimenezii*, and *G. koehneana*, all of which appear to flower later, possibly from April through August. More extensive collections and observations are required to verify this pattern. Living collections of *G. ginorioides* in the Cienfuegos Botanical Garden, Cuba, flowered in March prior to leaf expansion, whereas the same species in Villa Clara, growing on dry rocky serpentine, in the same week had not begun to leaf or flower (pers. obs., 2003) but was said to flower in the area as late as June, well after leaf development. Under greenhouse cultivation, *G. americana* and *G. rohrii* were observed to flower after leaf formation. Herbarium specimens of *G. rohrii* collected in the wild indicate that flowers can appear before leaves. Flowering in *G. rohrii* is primarily from February to May, but flowers do appear intermittently at other times. *Ginoria nudiflora* began flowering in the greenhouse prior to new leaf expansion and continued to flower after leaves were fully expanded (pers. obs.). The species has been collected in flower from March to June. Old fruits and pedicels tend to be persistent in *Ginoria*. *Haitia buchii* is known in leaf and flower from March to June and *H. pulchra* from February to July, approximately in the same season as *Ginoria*. *Tetrataxis*, at approximately the same latitude in the Southern Hemisphere as *Ginoria* and *Haitia* are in the Northern Hemisphere, is known to flower at least from February to May, with fruits observed in March and some pedicels and old fruits persisting into the next season as they do in *Ginoria* and *Haitia*. *Crenea* appears to flower and fruit throughout the year, with abundant young buds and flowers present from ca. August to November.

FLORAL MORPHOLOGY

Flowers of all perennial genera of the Lythraceae consist of a thickened perigynous floral cup (hypanthium) with valvate sepals surrounding a superior ovary (Fig. 4A). Beneath the base of the ovary, the floral cup in many of the genera is extended by an epipodium (sensu Troll, 1964; anthopodium of Briggs & Johnson, 1979), which is interpreted as the distalmost internode of the axis before the flower. The epipodium terminates basally at a pair of bracteoles (prophylls) at the first node below the flower. In *Ginoria*, the epipodium varies in shape with the species, being slender and exceptionally long in *G. americana* (2–7.5 mm), stout in *G. arborea* (0.5–1 mm), and absent in *G. callosa*. In most species it is slender and 1–3 mm. In the large flowers of *Haitia buchii* it is slender and 5–6 mm long; in the smaller flowers of *H. pulchra* it is stout and 1–2 mm long. The epipodium in *Crenea* (1.5–3 mm) and *Tetrataxis* (6–12 mm) is broad and tapers gradually from the base of the ovary to the bracteoles. The bracteoles are typically thin and caducous in all the genera, but in *G. callosa* they are coriaceous and well developed.

Flowers of all the Lythraceae are globose to subglobose or obovoid in bud, with four to six (rarely seven or more) deltate sepals. The veins or "ribs" that constitute the vascular supply to the sepals, stamens, and petals are usually visible on the floral cup and sepals. Outgrowths termed epicalyx segments (the appendages of Koehne, 1882, 1885a, 1903) develop at the sinuses of the lobes in the majority of genera of the family, although not always in all species. They

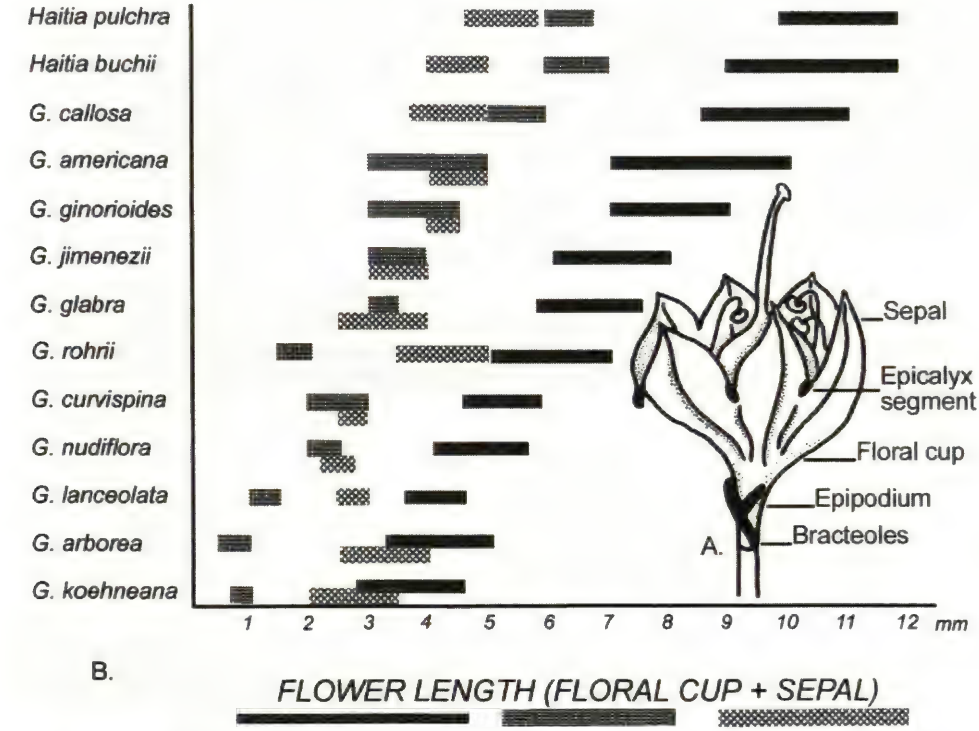

Figure 4. Length of floral components for *Ginoria* species discussed in this treatment. —A. Generalized *Ginoria* flower composed of the floral cup, sepals, and epicalyx segments, illustrated with associated epipodium and bracteoles at the first node below the flower. —B. Length of floral components. Solid bar = range of the combined length of the floral cup and the sepal; hatched bar = range in length of the floral cup measured from the base of the ovary to the sinus of the sepal; X-pattern bar = range in length of the sepal.

exhibit the greatest diversity of form in *Ginoria* and *Haitia*, where their shape and size are diagnostic of the species. Epicalyx segments are small, flattened, or corniform growths (*G. curvispina*, Fig. 21C; *G. ginorioides*, Fig. 23B, C); enlarged pouch-like growths that are accompanied by additional ruffled tissue decurrent on the subtending "rib" or vein (*G. callosa*, Fig. 20C); or encircling flanges as a result of the fusion of adjacent epicalyx segments (*G. glabra*, Fig. 25C; *H. buchii*, Fig. 18B; *H. pulchra*, Fig. 34B). They are absent in *G. americana*, *G. arborea*, *G. jimenezii*, *G. koehneana*, *G. lanceolata*, *G. nudiflora*, and *G. rohrii*, and in *Tetrataxis* and *Crenea*.

The total length of the flower cited in the species descriptions is the sum of the measurements of the floral cup, sepals, and the epipodium. Although the epipodium developmentally is not part of the flower, it superficially appears to be part of the floral cup and is included in the total measurement for this reason. The length of the floral cup is measured from the base of the ovary to the sinus at the base of the sepal (Fig. 4A). The sepal length is measured from the sinus to the sepal apex. Total floral length in *Ginoria* varies from shortest in *G. koehneana* (3–4.5 mm) to longest in *G. callosa* (8.5–11 mm). Flowers in *Crenea* are within the same size range (6–9.5 mm), are slightly longer (11–18 mm) in *Haitia*, and are longest in *Tetrataxis* (20–25 mm).

Species in *Ginoria* vary considerably in the ratio of sepal length to floral cup length, raising the question of whether floral evolution in the genus involved an equal increase in floral cup and sepal length or whether one component increased proportionally over the other, approaching either a more open or a more tubular floral form. In *G. arborea*, *G. koehneana*, *G. lanceolata*, and *G. rohrii*, the floral cup is shorter than the sepals without overlap in length (Fig. 4B). These are also among the smallest flowers in the genus. In *G. callosa*, *Haitia buchii*, and *H. pulchra*, the floral cup is the longest part of the flower and the sepals are proportionally shorter without overlap in length. These are the largest flowers. In the remaining species of *Ginoria*, and in *Tetrataxis* and *Crenea*, the floral cup is shorter to equal the length of the sepals, and the lengths of the cup and sepals overlap. The ratio of floral cup to sepal varies from 0.2–0.5 in species in which the sepals are longer than the floral cup and 1.2–1.5 in species in which the floral cup is longer than the lobes. The evolutionary course of this character is addressed following phylogenetic analysis (see Character Evolution).

The color of the mature floral cup, sepals, and/or ovary in *Ginoria americana*, *G. callosa*, *G. curvispina*, *G. ginorioides*, *G. nudiflora*, and *Haitia buchii* develops to various degrees from green to wine-red. Other species of *Ginoria* may possibly redden with age, but such observations have not been recorded.

Flowers in *Ginoria* are basically 4- or 6-merous, but merosity is flexible, as it is in most other genera of the Lythraceae (Dahlgren & Thorne, 1984). Merosity as cited in the species descriptions refers to the basic condition that is exemplified by the number of sepals and petals prevalent in the species, with stamen number and ovary locular number being more variable. Occasional 5-merous flowers can be found on plants with predominantly 4-merous or 6-merous flowers. Infrequently, 7-merous flowers occur. The following species typically have 4-merous flowers: *G. arborea*, *G. jimenezii*, *G. koehneana*, *G. lanceolata*, *G. nudiflora*, and *G. rohrii*. Flowers are typically 6-merous in: *G. americana*, *G. callosa*, *G. curvispina*, *G. ginorioides*, *G. glabra*, *Haitia buchii*, and *H. pulchra*. Flowers of *G. ginorioides* can range from 5-merous to 7-merous on a single plant (pers. obs.). One specimen introduced from a wild population to the Cienfuegos Botanical Garden in Cuba produces flowers with an indeterminate number of petals and up to 55 stamens, further evidence of the floral plasticity in this genus. Flowers of *Tetrataxis* and *Crenea* are consistently 4-merous.

Petals in the majority of *Ginoria* are large (to 20 × 15 mm in *G. callosa*) and showy. Petals in *G. arborea* and *G. koehneana* are exceptionally small for the genus (2–4 × 0.5–2 mm), scarcely exceeding the sepals. Clawed petals with claws to 2 mm long occur in *G. americana*, *G. curvispina*, *G. ginorioides*, *G. glabra*, *G. koehneana*, and *G. nudiflora*. Four species have white petals: *G. arborea*, *G. koehneana*, *G. nudiflora*, and *G. rohrii*. Petal color is intense rose or rose-purple or violet-purple in the rest of *Ginoria* and in *Haitia*. White petals with purple venation can occur in *H. pulchra*. Petals are absent in *Tetrataxis* and cream to white in *Crenea*. Petal length ranges from 2–20 × 0.5–15 mm across the genera. The petals in *Haitia* are 12–14 × 10–14 mm, within the range of the larger-petaled species of *Ginoria*.

Stamen numbers in *Ginoria* range from eight in *G. lanceolata* to 30 to 31 in *G. callosa* (Fig. 5). Stamen number is flexible in all species except *G. lanceolata*, which, however, is known only from a single flower. Four-merous flowers have (eight to)12 to 24(to 40) stamens and 6-merous flowers have 12 to 40(to 55) stamens. The 6-merous species, *Haitia buchii*, *H. pulchra*, and *G. callosa*, consistently have 24 or more stamens. The continuum of stamen numbers and plasticity of stamen production limit the use of specific stamen numbers as a reliable means of distinguishing species in *Ginoria* or separating *Haitia* from *Ginoria*. Stamens in both genera are arranged in a single whorl at the distal margin of a smooth tissue layer that lines the floral cup extending from the base of the cup to the level of stamen emergence. The antesepalous stamens (inserted in front of the sepals) are solitary and only rarely proliferate, whereas the antepetalous ones as a result of chorisis appear in multiples of 2× to 6× the number of sepals (−10× in cultivated *G. ginorioides*). Occasionally, a staminal filament divides after filament growth begins, producing a dichotomous filament with two fully formed anthers (pers. obs.). In *Tetrataxis* there are four exclusively antepetalous stamens, and in *Crenea* typically 12 stamens occur in a single whorl, one at each antepetalous position and two at each antesepalous position. The number in *Crenea* can range from possibly eight (Lourteig, 1986) to 15.

The position of the stamens on the floral cup varies from nearly basal, surrounding the ovary, to ca. 1–2 mm below the sinuses of the sepals at the margin of the cup. In *Ginoria americana* and *G. curvispina*, the stamens are nearly basal and an inner tissue layer is scarcely evident. In the other species of *Ginoria* and in *Haitia* and *Crenea*, an inner lining of tissue extends from the base of the ovary to the level of stamen emergence. This layer is glossy and apparently nonnectiferous in *Ginoria* and *Haitia*. The margin of this tissue forms a narrow, freestanding collar in *G. nudiflora* with the stamens emergent at its base (Fig. 6). The tissue margin is narrowly free in *G. glabra*, *G. callosa*, *H. buchii*, and *H. pulchra*; the stamens emerge along the free edge in these species. In *G. callosa* and *H. buchii*, the floral cup appears also to enlarge, forming a ring just at the base of the sepals on the inner surface. In all species except *G. koehneana*, the staminal filaments are long, densely packed in the bud, and long-exserted or partially curled back into the floral cup at anthesis. In *G. koehneana*, the stamens and petals are so short as to scarcely surpass the sepals, suggesting that the species may be self-fertilizing. Anthers in *Ginoria*, *Haitia*, and *Tetrataxis* are versatile, elongated, dehiscent by two longitudinal slits, and revolute. In *Crenea*, they are basifixed.

The gynoecium in all genera consists of a superior, sessile, globose to oblong ovary that may be shallowly 2- to 6-furrowed; a single long-exserted style (included or short-exserted in *Ginoria koehneana*), and a small capitate to subpunctiform stigma. The stigma in

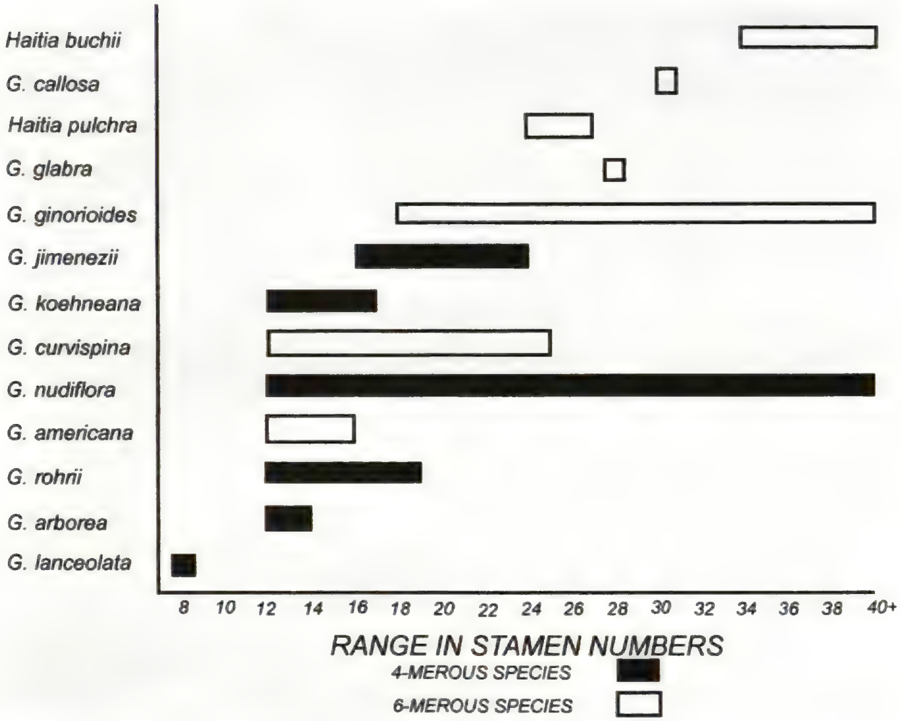

Figure 5. Range in stamen numbers for *Ginoria* species discussed in this treatment.

G. nudiflora is wet at time of pollen receptivity (pers. obs.). The stigma condition at receptivity for other taxa is not known. Ovary locules are separated by thin, membranous septa attached to a thick, fleshy axile placenta that is circular to triangular in transverse section. A small opening is present at the apex of each septum, so that the septa are incomplete. The taxonomic placement of *Ginoria* in the tribe Nesaeeae Koehne is thus in conflict with the tribal classification that defines the Nesaeeae by their complete septa. Koehne (1885a: 31) was aware that *Ginoria* and *Lagerstroemia* lacked the character of

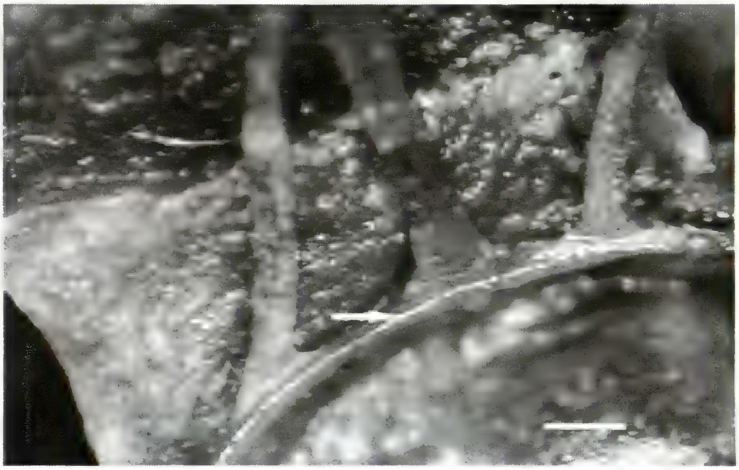

Figure 6. *Ginoria nudiflora*, interior of flower illustrating the narrow collar of tissue below the sinuses of the sepals at the level of stamen insertion (arrow); three staminal filaments visible (*Gutiérrez B. 3099*, MO). Scale bar = 2 mm.

their tribe. Subsequent studies have shown that the septa are incomplete at the distal end of the locule in all genera of the Lythraceae, thus negating the basis of the tribal division (Tobe et al., 1998). Nectaries are absent in *Ginoria*, *Crenea* (Tobe et al., 1998), and *Haitia* and present in *Tetrataxis* (Graham & Lorence, 1978). Flowers of *Ginoria* attract great quantities of bees for the abundant pollen they produce (pers. obs.).

The fruits in *Ginoria*, *Haitia*, and *Tetrataxis* are dry, 2- to 6-locular capsules with septifragal dehiscence; the septa split longitudinally as the fruit matures. Carpels number three to six in 6-merous flowers and two to four in 4-merous flowers. The primary valves subsequently split at the apex, becoming bilobed, or they may split further. The sturdy style is retained at the apex of the placenta after capsular dehiscence. *Crenea* produces indehiscent capsules that split irregularly with age.

SEEDS

Seeds of *Ginoria* are minute, averaging 1.2 × 0.3 mm, and are produced in high numbers (Figs. 7, 8). Koehne erected two sections in subgenus *Ginoria* based primarily on differences in seed shape and thickness of the seed coat (Koehne, 1903). Seeds in section *Ginoria* (≡ section *Prismatospermum*) were described as obovoid-prismatic, suboblique, retuse, and grayish white with a thick seed coat. *Ginoria americana* is the only representative of the section. Seeds in section *Discospermum* were described as complanate and obovate-orbicular (*G. curvispina*), elliptic (*G. glabra*), or oblong-elliptic (*G. ginorioides*). The seeds of subgenus *Antherylium* Koehne were described as complanate (*G. nudiflora* and *G. rohrii*).

Seed shape in *Ginoria americana* is not as disparate in the genus as originally described by Koehne. Although subrectangular seeds can be seen (Fig. 7A), variation includes more elongate seeds with a less rectangular-prismatic, more tapered obovate form like the seeds of *G. curvispina* (Fig. 7C) and *G. callosa* (Fig. 7D). The whitish seed color in *G. americana* reported by Koehne has not been observed; all seeds studied were golden brown. A major difference between seeds of *G. americana* and the other species is the presence in *G. americana* of a thicker mesotesta composed of uniformly tiny, densely packed, non-layered cells that must very effectively buoy seeds on their release into the streams where *G. americana* grows. The seed coat of all other species is more fragile, and no dense spongy mesotesta is apparent in hand sections. Rather, the mesotesta is multilayered and the cells mostly collapse when dry. Seeds of other species are elongate and obovate, oblong-elliptic, falcate, convex abaxially and slightly concave adaxially, with an obtuse to cucullate apex (Fig. 7C, D). The raphe extends the length of the concave adaxial side, terminating near the chalazal end. Seeds of *G. nudiflora* (Fig. 7B) and *G. rohrii* are exceptional, being longer, fusiform, and very fragile. Externally, the epidermal cells of the seed coat in all species are elongate, rectangular in outline, with straight to slightly undulating walls.

Seeds of *Haitia* (Fig. 8) and *Tetrataxis* possess the same morphology as the typical *Ginoria* seed (Fig. 7C, D; *Tetrataxis* seed, fig. 2A in Graham & Lorence, 1978). Seeds of *Tetrataxis* are ca. 1 × 0.3 mm and virtually identical to those in *H. pulchra*. Seeds of *Crenea* are oblong, narrowly elongate, and slightly falcate but differ from those in *Ginoria* by the production of a large-celled float tissue on the adaxial surface and by their greater size at ca. 2.5 × 0.5 mm.

Anatomically, the seed coat in *Ginoria* develops from a multilayered outer integument (testa) and a bilayered inner integument (tegmen). The innermost testal layer is sclerotic, and the exotegmen consists of small, more elongate, thick-walled tracheoids. This pattern agrees with the general pattern found in the Lythraceae (Corner, 1976: 176–177; Graham, 1995). The seeds of some Lythraceae, however, display a feature unique to all angiosperms, i.e., internally formed epidermal trichomes that evert from the cell upon wetting. These occur in 17 of the 32 genera, including *Ginoria* (verified in *G. glabra*, *G. nudiflora*, *G. rohrii*), *Crenea*, *Haitia pulchra*, and *Tetrataxis*. The trichomes are simple, straight (as opposed to spiralled in some other genera), unornamented extensions 55–62 × ca. 8 μm (Fig. 8A, B). The anatomy of *Ginoria* seeds has not been fully explored and could yield further information of phylogenetic and taxonomic value.

The seeds of the Lythraceae produce oil in the embryo. The composition of the oil varies among the genera, with the majority of genera emphasizing linoleic acid (C18:2) as the primary fatty acid and palmitic acid (C16:0) as the secondary component (Graham & Kleiman, 1987). *Ginoria* shows this pattern, which is also the pattern common in angiosperms generally. Based on analysis of *G. nudiflora*, the seed oil is 65% C18:2 and 19% C16:0. The same pattern occurs in *Tetrataxis*; seed oils in *Haitia* and *Crenea* have not been analyzed.

POLLEN MORPHOLOGY

Pollen of *Ginoria* has been described and compared to putative relatives as part of a series of studies on pollen of the Lythraceae (Graham et al., 1985). It varies from slightly prolate to prolate-spheroidal and circular in cross section, and is tricolporate and heterocolpate (Fig. 9A, B). There are three equidis-

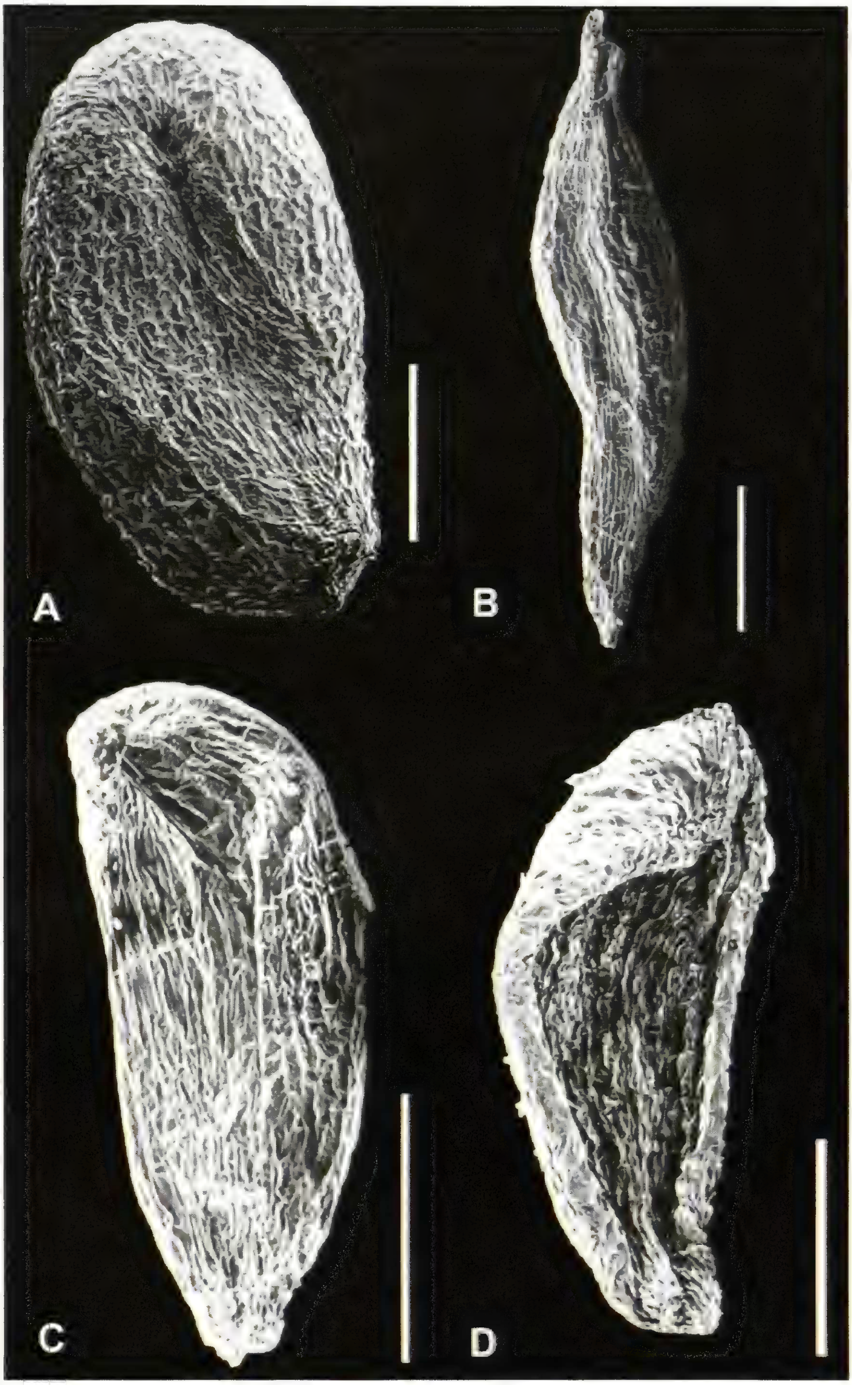

Figure 7. SEM micrographs of *Ginoria* seeds. —A. *G. americana* var. *americana* (*Britton 6742*, US). —B. *G. nudiflora* (*Miranda 7184*, US). —C. *G. curvispina* (*Wright 2545*, NY). —D. *G. callosa* (*Ekman 4870*, MO). Scale bars: A, C, D = 500 µm; B = 1 mm.

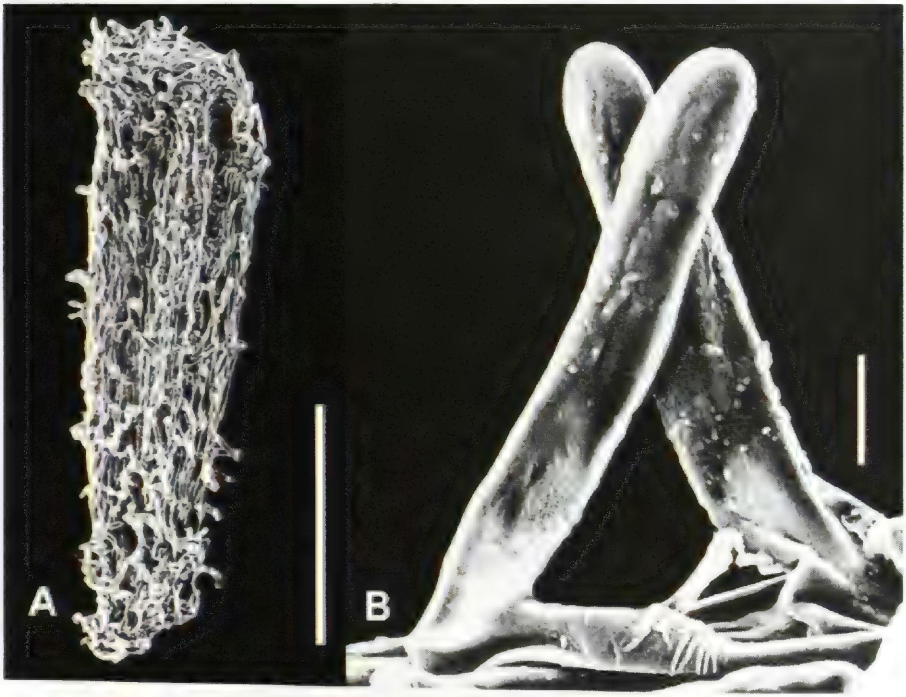

Figure 8. Seed of *Haitia pulchra* (*Ginoria pulchra*). —A. Wetted seed, adaxial (raphal) view, trichomes extended. —B. Two individual seed trichomes. Scale bars: A = 500 µm; B = 30 µm. A, B from *Ekman s.n. in 1923* (S).

tant functional colpi and six shorter pseudocolpi, which are arranged in pairs between the functional colpi. Germination pores are circular and situated at the midpoint of each colpus. The pollen wall varies in thickness from 1.5–2.5 µm, and exine sculpture varies from nearly psilate to distinctly scabrate. Grains are within the average size range for genera of the Lythraceae at 23–39 µm polar diameter × 23–29 µm equatorial diameter. Pollen characters do not vary sufficiently among the species to be significant taxonomically. The pollen of *Haitia buchii* and *H. pulchra* is indistinguishable from *Ginoria* except that

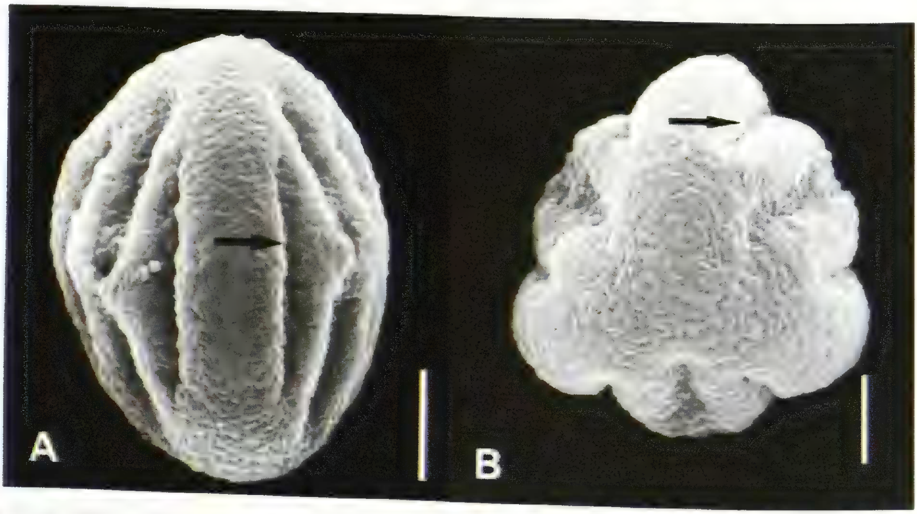

Figure 9. Pollen of *Ginoria ginorioides*. —A. Equatorial view. —B. Polar view. Arrows mark pseudocolpi. Scale bars: A, B = 3 µm. Photo by Joan Nowicke from *Ekman 18824* (US).

the pollen wall is slightly thicker (Graham et al., 1987).

The presence of six pollen pseudocolpi occurs in approximately one third of the genera of the Lythraceae: *Ammannia*, *Crenea*, *Ginoria*, *Haitia*, *Hionanthera* A. Fern. & Diniz, *Lafoensia* Vand., *Lagerstroemia*, *Lawsonia*, *Nesaea*, *Pemphis* J. R. Forst. & G. Forst., and *Rotala* L. Pollen of *Crenea* differs from the other members of the 6-pseudocolpate group by its verrucate exine and by absence of margins (costae colpi) along the colpi (Graham et al., 1985). The pollen of *Tetrataxis* differs conspicuously from *Ginoria* pollen and that of other putative close relatives by lack of pseudocolpi, presence of prominent mesocolpal ridges, conspicuous apertural fields, and a psilate exine (Graham et al., 1990).

CHROMOSOME NUMBERS

The basic chromosome number for the Lythraceae is eight, a number held by at least eight of the genera (Graham & Cavalcanti, 2001). *Ginoria* is a paleopolyploid with $x = 28$. *Ginoria*, *Tetrataxis* ($x = 28$), and *Crenea* ($x = 32$) have the highest basic numbers in the family. The chromosome number in *Haitia* is unknown. Within *Ginoria* the chromosome number is constant for the three species counted to date. *Ginoria americana* var. *americana* (count published as *G. glabra*), *G. nudiflora*, and *G. rohrii* have $2n = 56$ (Tobe et al., 1986; Graham & Cavalcanti, 2001). The constancy in chromosome number in early-diverging (*G. nudiflora*) and derived (*G. americana* and *G. rohrii*) species following phylogenetic hypotheses of this study suggests that ancestral *Ginoria* was a high polyploid prior to radiation in the Caribbean and that speciation was not accomplished through changes in chromosome number, as in some other genera of the family (Graham & Cavalcanti, 2001). Speciation in *Ginoria* most likely involved changes at the allelic level or chromosomal rearrangements rather than polyploid or aneuploid events. A similar constancy in chromosome number in the family is seen in the species-rich woody genus *Diplusodon* Pohl and is in contrast to the condition in the herbaceous genera *Ammannia*, *Cuphea* P. Browne, *Lythrum* L., and *Rotala*, where a wide array of aneuploid numbers and polyploid levels occurs.

REPRODUCTIVE BIOLOGY

Most species of *Ginoria* and *Haitia* initiate flowering in February or March, but flowering can commence as early as January or as late as June, depending on local or seasonal conditions or the species. The limited collection data available suggest that *G. callosa*, *G. glabra*, *G. koehneana*, and *G. jimenezii* flower from June to August. Flowers appear before the new leaves of the season, with the leaves, or after new leaf production. The appearance of flowers prior to new leaves does not seem to be a fixed species characteristic but is influenced by local conditions, possibly by the availability of water. Phenological data reported here are gleaned primarily from exsiccata labels and protologues. More field observations are required to accurately delimit flowering times for each species and determine the relationship of leafing to flowering time.

Ginoria is assumed to be outcrossed as judged by the long style and exserted stamens. No data are available on reproduction for *Crenea*, *Haitia*, or *Tetrataxis*, although all have similarly exserted styles and stamens, suggesting that outcrossing occurs. Trees of *G. nudiflora* in Mexico attract great numbers of bees for the abundant pollen produced during the brief weeks of flowering, and honey bees and euglossid bees have been observed on the flowers of *G. americana* in Cuba (pers. obs.). The flowers of *Ginoria* are nectarless and odorless from personal observations of *G. americana*, *G. curvispina*, *G. ginorioides*, *G. nudiflora*, and *G. rohrii*. Single plants of *G. americana*, *G. nudiflora*, and *G. rohrii* flowering (not simultaneously) in a greenhouse accessible to bees set no seed, suggesting that they are self-incompatible or have a low degree of self pollination. Most genera of the Lythraceae are self-compatible but require pollinators for pollen transfer (pers. obs.). No specimens of suspected hybrid origin have been noted in collections of the Cuban species of *Ginoria*. I have collected *G. americana* and *G. ginorioides* within a meter of one another in Villa Clara, and *G. curvispina* and *G. koehneana* separated by a few hundred meters in coastal Las Tunas Province. In each case, only one species was in flower. Although the flowering periods among *Ginoria* species appear to show considerable overlap, actual number of days of flowering and stigma receptivity may be short. *Ginoria americana* flowers throughout much of the year. Trees of *G. ginorioides* at the Cienfuegos Botanical Garden, Cuba, display flowers with petals for only one week of the season (H. Garcia, pers. obs., 2003). The dry floral cups and dehisced capsules of the previous season frequently persist on strongly attached pedicels in *Ginoria* after flowers of a new season appear.

HABITAT AND DISTRIBUTION

All but two species of *Ginoria* are restricted to the Greater Antilles, where they are part of the extensive endemic flora of the islands of Cuba and Hispaniola (Santiago-Valentin & Olmstead, 2004; Appendix 3).

The two exceptions are *G. nudiflora*, endemic to southern Mexico, and *G. rohrii*, whose range extends from the dry coastal forests of Puerto Rico eastward to the Virgin Islands. Six species are endemic to Cuba: *G. americana*, *G. arborea*, *G. curvispina*, *G. ginorioides*, *G. glabra*, and *G. koehneana*. Three species, *G. callosa*, *G. jimenezii*, and *G. lanceolata*, together with *Haitia buchii* and *H. pulchra*, are endemic to Hispaniola. Species of *Ginoria* are typically members of dry submontane forests or coastal thickets with a propensity for serpentine and calcium-based soils. No *Ginoria* or *Haitia* occur in Jamaica, although there are extensive karst habitats similar to those in Cuba and Haiti occupied by these genera.

In Cuba, *Ginoria* is found in all three phytogeographical provinces, Western, Central, and Eastern (Borhidi, 1996). *Ginoria americana* and *G. ginorioides* are the most widespread on the island, occurring in the three phytogeographic provinces, with *G. americana* var. *americana* the most commonly occurring taxon. Because *G. americana* grows in a riverine habitat, it is not constrained by the same edaphic and climatic limitations that are imposed on other members of the genus in dry forests or on limestone. *Ginoria ginorioides*, primarily distributed in the Western and Central provinces with rare, scattered occurrences in the Eastern Province, also grows along rivers but more typically appears on drier forest slopes. It occurs on serpentine soils in the serpentine area of Santa Clara, Villa Clara in the Central Province, and farther south it also grows in dry forests on limestone in the Trinidad Mountains. *Ginoria curvispina* is common in the eastern part of the Central Province as a species of the isolated Las Villas, Camagüey, and Holguín serpentines in dry scrub woodlands and overgrazed savanna and also on limestone in these areas. Disjunct populations at the extreme western end of Cuba in southern Pinar del Río grow on sandy soils. *Ginoria americana* var. *spinosa* has a limited distribution within the range of the nominal variety in Central Province in the same serpentine savannas and scrubland as *G. curvispina*. *Ginoria koehneana* is another facultative serpentine species with three highly disjunct populations along the northern coast of Cuba. Those in the Western phytogeographical province occur in thickets on the old serpentine Sierra de Cajálbana and at the coastal Toscano–Playa Murillo area on serpentine inland from the mangroves. In the eastern part of the Central Province, several populations are known along the coast near Puerto Padre, also inland from the mangroves, on limestone. A single collection made in 1916 is known from the Eastern Province growing in ferruginous soil on limestone in a dry forest. Two species, *G. arborea* and *G. glabra*, have partially sympatric distributions on the southern coast in the Eastern Province, an area renowned for its rich, highly endemic, xeromorphic flora (Borhidi, 1996). The species grow in coastal thickets on limestone terraces and inland on slopes in dry forest.

In Hispaniola, *Haitia buchii* and *Ginoria jimenezii* are dry woodland species on limestone, occurring in areas similar to those of *G. ginorioides* in Cuba. Distribution of *H. buchii* follows the principal mountain ranges of the island whose east-west axis extends from the Massif de la Hotte in Haiti into the Cordillera Central in the Dominican Republic. *Ginoria jimenezii* is isolated from *H. buchii*, occurring north of the Cordillera Central in the Dominican Republic in the Cibao Valley and north across the Cordillera Septentrional in dry forest close to the northern coast. *Ginoria callosa*, *G. lanceolata*, and *H. pulchra* are narrow endemics restricted to the coastal limestone cliffs and terraces of northern coastal Haiti, in habitats like those occupied by *G. arborea* and *G. glabra* in southeastern Cuba. At the eastern end of the range of *Ginoria* in Puerto Rico and islands to the east, the sclerophyllous *G. rohrii* grows in coastal dry forest and thorny thickets over limestone, habitats like those occupied by *Ginoria* in Cuba and Hispaniola. The species is occasionally also found in low coastal woodlands flooded with brackish water. At the western limits of *Ginoria*, the large tree species *G. nudiflora* is an endemic riverine and low coastal forest species in southern Mexico, distributed from coastal beach thickets in Veracruz into low montane forests in Oaxaca and Chiapas. It is also found disjunctly in dry coastal hills bordering the Pacific Ocean in western Michoacán, Mexico, there possibly through accidental introduction (Fig. 33).

PHYLOGENY

The phylogenetic position of *Ginoria* within the Lythraceae and the phylogeny of the genus itself have been partially explored in two earlier publications. In a family-level study with nuclear ribosomal DNA (rDNA) ITS (ITS-1, 5.8S gene, ITS-2; Graham et al., 2005) sequences, *G. americana* was included as the single exemplar of the genus. *Ginoria* + *Tetrataxis* were sister to *Ammannia* + *Nesaea*, and *Lawsonia* was weakly supported (55% bootstrap support [BS]; Felsenstein, 1985) as sister to the four genera. In the same study, variation in chloroplast sequences from *rbcL* and *trnL-F* (*Tetrataxis* not included) showed *Lawsonia* + *Ginoria* sister to *Ammannia* + *Nesaea*. A parsimony analysis of *Ginoria* based on morphology that included *Crenea*, *Haitia*, *Lawsonia*, and *Tetrataxis* found *Haitia* nested within *Ginoria*, whereas the sister to *Ginoria* was unresolved (Graham, 2002).

Table 1. ITS GenBank accession numbers and vouchers for new molecular sequences in *Ginoria* employed in the molecular phylogenetic analysis of this study.

Species	Origin	Voucher	GenBank accession number
Ginoria americana (1)	Cuba	*Graham 1137* (HAC)	EF407949
G. americana (2)	Cuba, cult. Fairchild Tropical Garden as *G. glabra*	*FG-1753C* (FTG)	AY078420
G. curvispina	Cuba	*Graham 1139* (HAC)	EF407950
G. jimenezii	Dominican Republic	*Garcia 3614* (MO)	AY078422
G. koehneana	Cuba	*Graham 1142* (HAC)	EF407951
G. nudiflora	Mexico	*Gutiérrez 3098* (MO)	AY078418
G. rohrii	Puerto Rico, Vieques Island	*Proctor 48846* (MO)	AY078419

Although a full molecular phylogenetic investigation of the genus is not possible at this time due to the rarity and/or unavailability of DNA for five endemic species of *Ginoria* and the species of *Crenea* and *Haitia*, a new expanded cladistic analysis of ITS data includes six species of *Ginoria*. A new morphological cladistic analysis is also presented with character selection and coding modified (Appendices 4, 5) from the earlier analysis (Graham, 2002).

MATERIALS AND METHODS

Molecular investigation. Fresh or silica gel–dried leaves of *Tetrataxis salicifolia* (Thouars ex Tul.) Baker and six species of *Ginoria* were used as a source of DNA to study sequence variation in nuclear rDNA ITS (18S rRNA, ITS-1, 5.8S gene, and partial ITS-2). The sequences obtained were added to those presently available for 27 genera of the Lythraceae to (1) further test the position of *Ginoria* that was recovered earlier based on *G. americana* alone (Graham et al., 2005) and (2) initiate exploration of phylogenetic relationships within the genus. GenBank accession numbers and vouchers for new sequences are listed in Table 1. Previously published molecular accessions utilized in this study are detailed in Graham et al. (2005).

Extraction procedures on 1 g of material per sample followed Doyle and Doyle (1987) as modified by the use of 6× CTAB to reduce problematic polysaccharides (Smith et al., 1991). The ITS region was amplified by using primers 5 and 4 of White et al. (1990). Amplification reactions were performed as in Freudenstein (1999) except that the buffer contained 100 mM Tris-HCl (pH 9.2), 30 mM $MgCl_2$, 250 mM KCl, and 5% dimethyl sulfoxide (DMSO). Sequencing reactions used the BigDye kit from Applied Biosystems (Foster City, California, U.S.A.) according to the manufacturer's instructions and were run on an ABI Model 377 sequencer (Applied Biosystems). The exceptions were *G. koehneana* and *Tetrataxis*, whose sequences were produced at Macrogen Inc. (Seoul, South Korea). Contiguous sequences were assembled with Sequencher (Gene Codes Corporation, Inc., Ann Arbor, Michigan, U.S.A.), aligned in Clustal X, and manually adjusted in MacClade 4.07 (Maddison & Maddison, 2000). Attempts to extract amplifiable DNA from herbarium materials of the putatively closely related genera *Haitia* and *Crenea* and from silica gel–dried leaves of *G. ginorioides* were unsuccessful after repeated attempts.

Morphological investigation. A data matrix of 19 taxa and 14 characters (Appendix 4) was constructed with seven binary and seven multistate characters for use in a morphological cladistic analysis as a second approach to assessing phylogenetic relationships in *Ginoria*. A single data cell was missing in the matrix. Two characters are vegetative and 12 are reproductive. The total number of characters was limited by close similarity among the species in habit, stem and wood anatomy, leaf architecture, and pollen morphology and by a continuum in size, shape, and number of vegetative and floral components. Three quantitative floral characters (characters 4, 5, and 9), whose states are separated by numerical gaps, were included in the matrix. The floral characters of the rare *G. lanceolata*, previously known only from sterile material, were included in an analysis for the first time through discovery of a flower among material of a second collection.

Phylogenetic analyses. Maximum parsimony analyses of the ITS and the morphological data sets were analyzed separately by using PAUP* version 4.0b10 (Swofford, 2002). For ITS analyses, *Combretum* Loefl. and *Quisqualis* L. in the Combretaceae and *Ludwigia* L. and *Fuchsia* L. in the Onagraceae were employed as outgroups. These two families are regarded as closest relatives to the Lythraceae (Graham et al., 2005). To test the monophyly of *Ginoria* in the morphologically based cladistic analysis, *Crenea*, *Ginoria*, *Haitia*, and

Tetrataxis were included in the ingroup. The outgroup consisted of *Ammannia*, *Decodon* J. F. Gmel., *Lagerstroemia*, *Lawsonia*, and *Nesaea*. *Decodon* and *Lagerstroemia* represent more distant relatives in the family. All characters were unordered and equally weighted. All analyses were performed to completion by using a heuristic search and the following settings: 10,000 random taxa addition replications with 10 trees held at each step, tree bisection-reconnection (TBR) swapping and MULTREES option in effect, and branches set to collapse if minimum branch length is zero ("amb-"). Evaluation of clade robustness used bootstrap analysis with 100 replicates, 250 random addition replicates, no more than two trees saved for each stepwise addition, TBR swapping, and MULTREES in effect.

RESULTS AND DISCUSSION

The family-level ITS parsimony analysis including six species of *Ginoria* produced a single tree of length 2510, consistency index (CI) = 0.43, and retention index (RI) = 0.63 (Fig. 10). The aligned length of the region was 714 characters, of which 443 (62%) were parsimony informative. All species of *Ginoria* are included in a strongly supported clade (96% BS) with *Lawsonia* at the base of the clade and *Ammannia* + *Nesaea* sister to *Ginoria*. The clade is one of the most strongly supported in the family as is its sister clade *Duabanga* Buch.-Ham.–*Sonneratia* L. f. (95% BS); in contrast, there is weak or no support at most of the other deep nodes of the family phylogeny (Fig. 10). With the addition of five species of *Ginoria* to the new ITS cladistic analyses, *Ginoria* is shown to be paraphyletic. *Ginoria jimenezii* is sister to the rest of *Ginoria*, and *Tetrataxis* is included within *Ginoria* at the node above *G. jimenezii*. Bootstrap support for the clade *Tetrataxis* + *G. nudiflora*–*G. curvispina* is 78%. *Ginoria americana* occupies a derived position within the genus. The terminal branches are long to *G. jimenezii* (27 changes), *G. nudiflora* (28 changes), and especially to *Tetrataxis* (45 changes), whereas only zero to nine changes appear on the subterminal and terminal branches of the derived clade *G. rohrii*–*G. curvispina*.

Parsimony analysis of the morphological data set for this revision yielded 22 minimum-length trees of length 33 (CI = 0.67, RI = 0.78), and the strict consensus was highly unresolved (Fig. 11). One weakly supported unresolved clade (60% BS) consists of *Ginoria arborea*, *G. koehneana*, *G. lanceolata*, and *G. rohrii*. A second, more strongly supported clade (88% BS) consists of two species of *Ginoria* and two species of *Haitia*. Again, *Ginoria* is paraphyletic, with part of the genus forming a clade with *Haitia*. The relationships of *Ginoria* to *Tetrataxis* and *Crenea*, the latter another possible congener, were unresolved in this morphologically based phylogeny.

Ginoria is well supported (96% BS) in the ITS phylogeny of the Lythraceae as a member of the Afro-Asian clade composed of *Lawsonia*, *Ammannia* + *Nesaea*, and *Ginoria* + *Tetrataxis*, but the sister to *Ginoria* remains equivocally *Lawsonia* or *Ammannia* + *Nesaea* (the latter two genera most likely congeneric, Graham et al., 2005). ITS results further support the hypothesis that *Ginoria* is monophyletic only when *Tetrataxis* is included, whereas morphological results find *Ginoria* monophyletic only when *Haitia* is included. An independent test of these hypotheses employing all relevant taxa, including *Crenea*, is critical to fully understand the limits of *Ginoria* and its relationships to those genera with similar morphological forms. The extensive changes in ITS that have accumulated with time in *G. jimenezii*, *G. nudiflora*, and *Tetrataxis* following divergence from a common ancestor taxa imply that they are considerably older than the numerous island-endemic species of Cuba and Hispaniola whose ITS sequences are closely similar to one another. The close ITS similarity of *G. rohrii*, *G. koehneana*, *G. americana*, and *G. curvispina* suggests their speciation in the Greater Antilles is relatively recent. The Puerto Rican species *G. rohrii*, which shares clade membership with the Cuban endemics in both molecular and morphological analyses, is not a close relative of *G. jimenezii* from the Dominican Republic, as might have been implied by their 4-merous, epicalyx-free floral morphology and close geographical affinity.

In one of the two clades generated in the morphological analysis, two species of western-central Hispaniola (*Haitia buchii* and *H. pulchra*) occur with *Ginoria glabra* of southeasternmost Cuba and *G. callosa* of northwestern Haiti. Their relationship is supported by shared derived 6-merous flowers with rose-purple petals and a well-developed epicalyx. In the second clade, flowers are 4-merous, exceptionally small for the genus, lack an epicalyx, and have white petals (petal color unknown in *G. lanceolata*). All occur in eastern Cuba or Hispaniola. The range of *G. koehneana* also includes sites on the northwestern coast of Cuba.

CHARACTER EVOLUTION

Exploration of character change is limited by the underrepresentation of species of *Ginoria* in the molecular data set and by lack of a well-resolved phylogeny based on morphology. Some ancestral states of the genus can be interpreted, however, based on outgroup versus ingroup changes mapped onto the

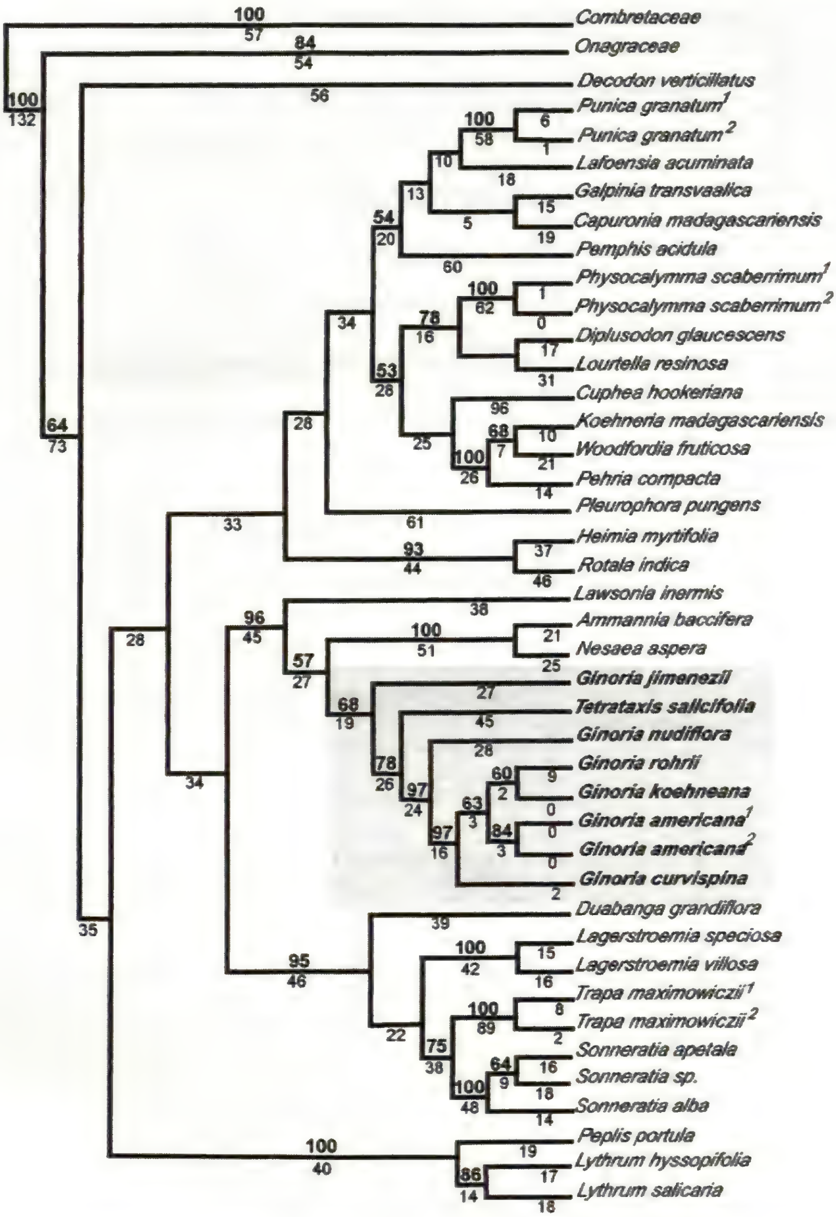

Figure 10. A phylogeny of the Lythraceae based on ITS sequences, including six species of *Ginoria* and *Tetrataxis salicifolia*. The one most parsimonious tree found: tree length = 2510, CI = 0.43, RI = 0.63. Superscript numbers indicate different collections of the same species. Bootstrap support values equal to or greater than 50% appear above the branches and branch lengths appear below.

ITS phylogeny. The earliest members of the genus were spineless shrubs or small trees with 4-merous flowers lacking an epicalyx. The ancestral flower had a floral cup approximately equal in length to the sepals. Divergence occurred both toward longer perigynous cups with short sepals and toward reduced floral cups with long sepals. Stamens numbered between 12 and 18 and were inserted above the base of the floral cup, and the pollen had pseudocolpi. The three earliest-diverging species in this study, *G. jimenezii*, *Tetrataxis salicifolia*, and *G. nudiflora*, present these plesiomorphic features. Aside from the

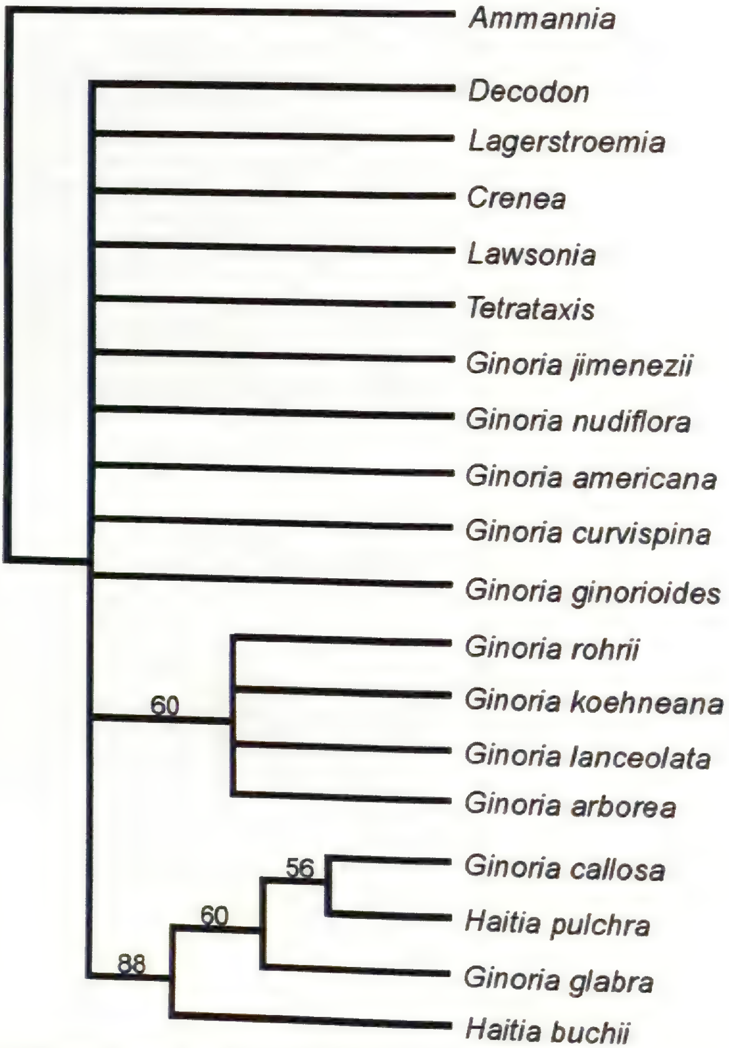

Figure 11. Morphologically based phylogeny of *Ginoria* and *Haitia* using *Ammannia*, *Crenea*, *Decodon*, *Lagerstroemia*, *Lawsonia*, and *Tetrataxis* as the outgroup. The strict consensus of the 22 most parsimonious trees: tree length = 33, CI = 0.67, RI = 0.78. Bootstrap support values equal to or greater than 50% appear above the branches.

ITS phylogeny, *G. glabra* and the species of *Haitia* have a prominent encircling epicalyx, which together with their 6-merous flowers and multiplicity of stamens promotes their clade relationship in the morphological phylogeny. Fruits changed from indehiscent or irregularly dehiscent capsules to dehiscent capsules with thinner-coated, more elongate, less compressed seeds. Seeds in *Ammannia/Nesaea*, *Crenea*, *Ginoria*, *Haitia*, and *Tetrataxis* have simple internal epidermal trichomes and lack the densely packed homogenous spongy tissue found in trichomeless seeds of *Lawsonia*.

BIOGEOGRAPHY

A first attempt to understand the historical biogeography of *Ginoria* from a phylogenetic perspective was limited to results from a morphological phylogenetic study (Graham, 2002); it placed *G. rohrii* from Puerto Rico as the first-diverging lineage of the genus. Several biogeographical scenarios were explored and it was ultimately concluded that (1) morphological characters were inadequate for basal resolution of the genus with confidence; (2) long-distance dispersal and random chance establishment played a major role in the evolution of the genus; and (3) radiation within *Ginoria* was multidirectional, both east to west and west to east.

The ITS results now place *Ginoria jimenezii*, a narrow endemic of central Hispaniola, as the first-diverging lineage of the genus. At successive grades above *G. jimenezii* are *Tetrataxis* from Mauritius and then *G. nudiflora* from Mexico. One hypothesis to explain this wide disjunction is that ancestral *Ginoria* stock originated in eastern Afro-Asia where *Lawsonia* and *Ammannia*/*Nesaea* occur today. The ancestral stock then dispersed over a long period of time and over great distances in both easterly and westerly directions. No fossils of *Ginoria*-like plants have been reported anywhere in the world to test this hypothesis. However, fossils of *Lawsonia*-like seeds from the middle Eocene of British Columbia indicate existence of the clade in North America by 48.7 million years ago (Cevallos-Ferriz & Stockey, 1988; Little et al., 2004). Koehne essentially posed this hypothesis (Koehne, 1885b: 34), speculating that a "*Ginoria* form" originated in northeastern Asia, subsequently migrated in one direction into America and in another southwestward into India, where it gave rise to *Tetrataxis*, which then spread from India to Mauritius. How and when *Ginoria* or its ancestral form first arrived in the Caribbean or how more recent radiation and speciation proceeded in the Greater Antilles remain speculative in the absence of fossil evidence and a full phylogeny. Radiation of the genus in the Caribbean was clearly multidirectional, and long-distance wind and/or water dispersal and chance establishment played major roles in its evolution. The phylogenetic position of the South American genus *Crenea*, when determined, will also affect the ultimate interpretation of the historical biogeography of *Ginoria* and relatives. An interesting dispersal story remains to be discovered to explain the wide intercontinental relationships of *Ginoria* and its relatives.

Within *Ginoria*, some phytogeographic patterns of relationship accord with those found in the few other studies of plant groups in the Caribbean for which phylogenetic reconstructions are available (Santiago-Valentin & Olmstead, 2004). Zona (1990) in *Sabal* Adans., and Lavin (1993) in *Poitea* Vent. and related genera found sister relationships between Mexican and Cuban species. Fritsch (2001, 2003) found the Hispaniolan *Styrax ochraceus* Urb. sister to *S. radians* P. W. Fritsch from southern Mexico and *S. obtusifolius* Griseb. from Cuba and Hispaniola sister to the endemic Puerto Rican *S. portoricensis* Krug & Urb. In *Ginoria*, Mexican–Greater Antillean relationships are seen with *G. nudiflora* from southern Mexico, *G. koehneana* from the north coast of Cuba, and *G. rohrii* from Puerto Rico and the Virgin Islands. Judd (2001) in *Lyonia* Nutt., and Lavin (1993) in *Poitea* found close relationships between species of eastern Cuba and north-central Hispaniola. Similar relationships are found between *G. glabra* in southeastern Cuba and *G. callosa*, *Haiti buchii*, and *H. pulchra* in western Hispaniola. *Ginoria* is absent from Jamaica and the Lesser Antilles. Judd (2001) suggested the absence of *Lyonia* from the Lesser Antilles was because the genus had dispersed from Mexico/eastern North America and presumably had not had time to disperse as far east as the Lesser Antilles. For *Ginoria*, I suggest that the prevailing northeast trade wind pattern and the North Equatorial Current, both of which direct wind and water currents from Africa and from South America westward away from the Lesser Antilles and Jamaica toward Cuba (Hedges, 2001), have prevented or limited dispersal of fragile *Ginoria* seeds to the south and southeast. The length of time suitable habitats have been available for colonization may also be a limiting factor. The oldest, presently emergent lands in Jamaica are young at ca. 10 million years (end of the Miocene) in comparison with parts of Cuba and Hispaniola, where emergent land has been continuously available since about 40 million years ago (Middle Eocene; A. Graham, 2003a, b). Emergent islands in the Lesser Antilles are of various ages since continuous emergence, some possibly quite young (e.g., Barbados, 1 million years, fide Speed & Keller, 1993). Only a few species of the Lythraceae have managed to become established in the Lesser Antilles, and these are adventive herbs from South America or their derivatives (Graham, 1989, 2003). A similar distributional pattern is also noted in *Styrax* (Fritsch, 2001; pers. comm.).

RATIONALE FOR TAXONOMIC CHANGES AT THE GENERIC AND SUBGENERIC LEVELS

The phylogeny generated from cladistic analysis of ITS sequence data places *Tetrataxis* within the *Ginoria* lineage; ITS sequences for *Haitia* and *Crenea* are missing (Fig. 10). Morphologically based analysis nests *Haitia* within *Ginoria* but leaves the relationship to *Tetrataxis* and *Crenea* unresolved (Fig. 11). The only complete comparative analysis is morphological; thus, taxonomic changes are limited to those results that position *Haitia* within *Ginoria*. The relationships of *Tetrataxis* and *Crenea* to *Ginoria* remain to be addressed.

Previous acceptance of *Haitia* depended on recognition of several character states as unique to the genus. These were the presence of the epicalyx flange, the greater number of stamens, a 6-locular rather than 2- to 5-locular ovary, and a slightly larger stigma. The same continuous epicalyx flange present in *H. buchii* and *H. pulchra* is, in fact, present in *Ginoria glabra*. The highest number of stamens reported in either genus ranges from 34 to 40 in *H. buchii* (Fig. 5), but nearly as many occur in *G. callosa* (30 to 31), *G. glabra* (28), and *H. pulchra* (24 to 27). Stamen number does not separate the two genera, and the common occurrence of stamen chorisis in *Ginoria* suggests that stamen numbers are too unstable to be considered taxonomically significant at the genus level. The same may be said for locule number, which varies within species of *Ginoria* and could well vary by one or more locules in *Haitia* were more flowers available for examination. The difference in stigma size is not significant, being larger in larger-flowered species and smaller in the smallest, regardless of the genus. There is no difference between *Ginoria* and *Haitia* in pollen and seed morphology. Wood anatomy does differ in some respects, but none of the species of *Ginoria* that are morphologically close to *Haitia* have been compared to *Haitia*, and regardless, wood anatomical characters in the Lythraceae are of a generalized nature within the order and highly homoplastic (Baas & Zweypfenning, 1979). An independent test of relationships employing molecular sequences is desirable, but attempts to obtain DNA from the limited number of exsiccatae of *Haitia* have been unsuccessful.

Lacking any autapomorphic character to exclusively define *Haitia* and separate it from *Ginoria*, *Haitia* is subsumed within *Ginoria* and treated as its synonym from here on in this revision. *Tetrataxis* is retained for the present as distinct from *Ginoria* despite the partial ITS phylogeny that places it within *Ginoria*. Unlike *Haitia*, *Tetrataxis* has accumulated many autapomorphic morphological and molecular differences relative to *Ginoria*. *Crenea* differs from *Ginoria* and *Tetrataxis* primarily by basifixed anthers and float tissue in the seed. I defer possible synonymization of *Tetrataxis* and *Crenea* with *Ginoria* until relationships are better informed by more extensive molecular data, including that of *Crenea* and additional species of *Ginoria*.

The subgeneric and sectional classification of *Ginoria* (Appendix 1; Koehne, 1903) was erected at a time when only six species were known and without the strength of a suite of definitive features. The single distinction between subgenus *Ginoria* and subgenus *Antherylium* is 6-merous versus 4-merous flowers. It is not clear at this stage in our knowledge how many times the ancestral 4-merous floral form in the evolution of the genus may have given rise to the 6-merous form or whether there were subsequent reversals. No other morphological characters appear in combination with floral merosity to support the recognition of two subgenera. The division of subgenus *Ginoria* (subgenus *Euginoria*) into section *Ginoria* (section *Primatospermum*) and section *Discospermum* based on seed characters and stamen number is also unsupportable. Seed shapes in *G. americana*, the sole member of section *Ginoria*, are more variable than Koehne knew. They range into the more complanate seed type seen in *G. curvispina* in section *Discospermum*, although some indeed are 4-angled and have a thicker seed coat. Stamen number is not valid either, being extremely plastic in most species (Fig. 5). The infrageneric classification of Koehne is not maintained in this revision.

THREATS TO EXTINCTION

The species of *Ginoria* endemic to Cuba and Hispaniola are under greatest threat. In Cuba, three species are particularly at risk. *Ginoria arborea*, *G. glabra*, and *G. koehneana* occupy specialized narrow habitats on coastal limestone and serpentine, and each is known from few localities. Their rarity is attested to by the few collections available, even though the areas have been studied floristically in recent years. Southeastern Cuba in particular has received special attention because of the high numbers of endemic genera and species present there (Borhidi, 1996). On the beautiful northeastern coast at Puerto Padre, the Cuban government has built a hotel complex next to one of the few known localities for *G. koehneana*. More extensive development of the Cuban coasts for tourism is likely and threatens these exceptional habitats.

The *Ginoria* species endemic to Hispaniola must be considered under extreme threat, if they are not already extinct. In Haiti, environmental destruction is well known; forests that once covered 93% of the land are now reduced to less than 2% (Brown, 2006). The forest-associated species *G. callosa*, *G. lanceolata*, and *G. pulchra* (Ekman & O. C. Schmidt) S. A. Graham are known from just eight collections. *Ginoria callosa* has not been re-collected since its discovery by Erik Ekman in 1925. *Ginoria lanceolata* is known only from the two collections made by Ekman in 1925 and 1928. *Ginoria pulchra* is represented by three collections: the Ekman type from 1927, an Ekman collection from 1929, and a collection by Tom Zanoni in 1985, all from the type area where it is now exceedingly rare or possibly extinct (see further notes following the species description of *G. pulchra*). The sites of all three species are on the extreme northwest coast of Hispaniola, which, together with the eastern Cuban phytogeographical province, has been called "the most prominent centre of speciation in the Antilles" (Borhidi, 1996). *Ginoria buchii* (Urb.) S. A. Graham, with a range extending across the border between Haiti and the Dominican Republic, is also rare today, known from four collections, and has not been seen since 1969. Searches for it since 1969 at former sites in the Dominican Republic have not been successful (for further details, see notes following the species description). In the Dominican Republic, *G. jimenezii* was considered "very rare" when originally described in 1954. It is known from the type and three additional collections, two of which are from a single sterile tree (R. G. García, pers. comm.).

IUCN Red List Assessments

As is apparent from the limited distributional ranges and sparsity of collections, some species of *Ginoria* might be extinct, and most of the remainder are at high risk of extinction. There are three exceptions: *Ginoria americana* var. *americana* with numerous populations throughout Cuba; *G. curvispina*, more localized in Cuba than *G. americana* but common within its range; and *G. nudiflora*, established in numerous localities in southern Mexico. Given the uncertain future protection of their habitats, the three are estimated as Near Threatened (NT) according to IUCN Red List criteria (IUCN, 2001). The distributions of *G. ginorioides* and *G. rohrii* are more fragmented with fewer populations. They are estimated as Vulnerable (VU). Endemic species of Cuba with narrow ranges and few known populations, i.e., *G. americana* var. *spinosa*, *G. arborea*, *G. glabra*, and *G. koehneana* are Endangered (EN). They could easily become critically endangered or extinct, especially if the coastal areas and the Sierra Maestra are developed for tourism without regard for their presence. The five species endemic to Hispaniola, i.e., *G. buchii*, *G. callosa*, *G. jimenezii*, *G. lanceolata*, and *G. pulchra*, are Critically Endangered (CR).

Nomenclature

Ginoria has an unfortunate history regarding the disposition of holotypes. The original material Jacquin used to describe the genus has not been located, and it is unlikely to exist when one considers that few collections by him from the West Indies have survived (D'Arcy, 1970; Stafleu, 1971). Subsequently, two historical circumstances in the 1900s have necessitated designation of lectotypes or neotypes for 12 of the 22 names treated in this revision. In the first instance, names authored by three botanists working at the Berlin Botanic Garden (B), Ignatz Urban, O. C. Schmidt, and Emil Koehne, were based on collections at B that are no longer extant. A possible exception was the material studied by Schmidt and said to be still largely intact in B (Stafleu & Cowan, 1985: 259). None of the *Ginoria* holotypes designated by him, however, are present there today (C. Oberprieler, pers. comm.). Secondly, the names proposed by August Grisebach (GOET) for new species collected by Charles Wright in Cuba present special difficulties because Wright's collections were sorted according to a number assigned by Asa Gray to each species rather than by individual field collection numbers (Graham, 2005). Specimens bearing the same species number were collected at different times and in different places, their labels often lack specific collection data, and plants sharing the same species number sometimes represent more than one species.

The complications associated with the Wright collections were investigated by Howard (1988), who selected lectotypes for many of Grisebach's species. Because these were presented in microfiche form, they were not effectively published (McNeill et al., 2006: Art. 7.10 and 29.1), and it was therefore necessary to revisit the specimens and the nomenclatural choices made and newly designate lectotypes (Graham, 2005). In the taxonomic treatment that follows, the types of the Grisebach names are cited with two numbers. The Wright number, i.e., the number cited by Grisebach in the protologue, is the species number assigned by Asa Gray to all collections of the same species on receipt of determinations from Grisebach. The number in parentheses after the Wright number is a preliminary number that was assigned by Gray to a specimen prior to sending it to Grisebach. I have treated all specimens with the same Wright number as isotypes or as isolectotypes, although, strictly speaking, they may not have been collected on the same day, in the same year, or even in the same place as the lectotype.

Taxonomic Treatment

Ginoria Jacq., Enum. Syst. Pl. 5. 1760. *Ginoria* subg. *Euginoria* Koehne [≡ subg. *Ginoria*] sect. *Prismatospermum* Koehne [≡ sect. *Ginoria*], Pflanzenr. (Engler) IV. 216: 248. 1903. TYPE: *Ginoria americana* Jacq.

Antherylium Rohr & Vahl, Skr. Naturhist.-Selsk. 2(1): 211, tab. 8. 1792. *Ginoria* subgen. *Antherylium* (Rohr) Koehne, Bot. Jahrb. Syst. 3: 351. 1882. TYPE: *Antherylium rohrii* Vahl (≡ *Ginoria rohrii* (Vahl) Koehne).

Ginoria subg. *Euginoria* Koehne [≡ subg. *Ginoria*] sect. *Discospermum* Koehne, Pflanzenr. (Engler) IV. 216: 247. 1903. TYPE: *Ginoria curvispina* Koehne [type of the section designated here from among the three species originally classified in the section].

Haitia Urb., Feddes Repert. Spec. Nov. Regni Veg. 16: 140. 1919. TYPE: *Haitia buchii* Urb. (≡ *Ginoria buchii* (Urb.) S. A. Graham).

Deciduous subshrubs to tall trees, bark red-brown or red-purple on young growth, gray-brown and corticating in thin fibrous strips on old growth; stems glabrous or rarely lightly puberulent, terminal vegetative bud often aborted; nodes enlarged, buttressed, the leaf scar forming a nodal shelf perpendicular to the stem; stems terete or 4-winged when young, terete with age, free ends of the wings in some species elongated and indurated forming 4 (less often 2) spines; spines short or long, thick or slender, blunt or sharp, erect, incurved toward the stem, spreading, or recurved. *Leaves* subsessile or petiolate, opposite (rarely subopposite), decussate or very rarely ternate, entire, ovate, obovate, lanceolate, elliptic, oblong, linear-lanceolate, or suborbicular, thinly to thickly membranous or distinctly coriaceous and shining, venation brochidodromous with a membranous to thickened margin and an intramarginal vein, or the intramarginal vein forming a distinctly cartilaginous margin, secondary veins typically visible, the tertiary veins less so and sparsely to densely reticulate, sometimes thickened on the abaxial leaf surface. *Inflorescences* simple racemes, or condensed umbel-like clusters, or flowers solitary, the flowers 1 to few (to 20) in the axils of the main and lateral shoots; pedicels long, slender, bearing bracteoles at the apex; bracteoles membranous, deciduous. *Flowers* 4- or 6(7)-merous, rarely multiplied, perfect, globose to obovoid in bud, glabrous, the sepals valvate, deltate; floral cup campanulate to shallowly so, membranous or coriaceous, green or green turning red with age especially within, abruptly or gradually contracted below the ovary to an epipodium or the epipodium absent; petals ovate, orbicular, or obovate to spatulate, sometimes clawed, white, intense rose, or rose- or violet-purple; stamens 8 to 40 or more, inserted individually or multiplied on the floral cup along the distal margin of a tissue lining the inner surface of the floral cup, the tissue narrow and encircling the base of the ovary or extended distally, the distal margin not free, or minimally free at the distal margin or extended to form a narrow freestanding collar, staminal filaments flattened, glabrous, red or green, exserted, rarely included, stamens sometimes crumpled back into the floral cup, anthers yellow, revolute; pollen prolate to prolate-spheroidal, tricolporate with 6 pseudocolpi, the exine psilate to distinctly scabrate; ovary 2- to 6-locular, globose to slightly depressed and 6-sulcate, the narrow, thin septal walls incomplete at the apex, the placenta central, ovoid to globose, enlarged at maturity; style sturdy, persistent at the apex of the axile placenta in fruit, generally long-exserted; stigma small capitate to punctiform. *Fruit* a septifragally dehiscent capsule, brown or wine-red, moderately thick-walled, 2- to 6-sulcate, the valves bipartite at the apex; seeds numerous, small, crowded and irregularly fully covering the surface of the enlarged placenta, golden to light brown, elongate, prismatic with 3 or 4 poorly defined sides or bilaterally compressed, obovoid, retuse at the apex and tapering to the base or fusiform and tapering toward both ends; seed coat thick to thin and fragile; embryo straight, the cotyledons oblong-spatulate, ca. twice as long as the radicle.

KEY TO THE SPECIES OF *GINORIA*

Two species that include both spiny and spineless plants appear twice in the key and are indicated by an asterisk (*). All measurements in the key and species descriptions refer to length unless otherwise indicated. Flower length is measured from the base of the epipodium at the bracteoles to the apex of the sepals.

1a. Sepals and petals 4 2
1b. Sepals and petals 6 8
2a. Plants armed at the nodes by 4 (less often 2) spines 3
2b. Plants spineless 6
3a. Spines slender, spreading to slightly ascending, 2–4 mm, tips straight to slightly recurved; leaves narrowly ovate-lanceolate to lanceolate, 10–25 × 4–15 mm; Haiti . . . . 10. *G. lanceolata*
3b. Spines robust, horn-like, incurved or recurved, spreading or slightly erect 4
4a. Spines incurved to erect, 1–4 mm; seeds narrowly fusiform; Puerto Rico and the Virgin Islands . . . . 13. *G. rohrii*
4b. Spines recurved, spreading or slightly erect, 1–2 mm (rarely incurved in *G. koehneana*, which has leaves 10–25 × 5–20 mm); seeds obovate to oblong-elliptic, concave-convex; Cuba 5
5a. Leaves linear-oblong to lanceolate or infrequently obovate, 10–40 × 3–16 mm; secondary veins in 3 to 5(to 8) pairs, tertiary veins slender, distinctly visible abaxially; floral cup scarcely contracted to a stout epipodium 0.5–1 mm . . . . 2. *G. arborea*
5b. Leaves obovate to suborbicular or oblong-elliptic, 10–25 × 5–20 mm, secondary veins in ca. 8 to 10 pairs, tertiary veins thick, obscure; floral cup abruptly contracted to a slender epipodium ca. 1 mm . . . . 9. *G. koehneana**
6a. Inflorescences racemose, flowers 1 or 2 per axil, 8–9 mm; petals violet, 12–17 mm; Dominican Republic . . . . 8. *G. jimenezii*
6b. Inflorescences loosely umbelliform, flowers 1 to 20 per axil, 3–8 mm; petals white or pale pink, 2.5–7 mm 7
7a. Leaves obovate to suborbicular or oblong-elliptic, 10–25 × 5–20 mm, margin white-cartilaginous; flowers 1 to 9 per axil; Cuba . . . . . 9. *G. koehneana**
7b. Leaves narrowly elliptic or lanceolate, 40–90 × 15–35 mm, margin membranous; flowers 8 to 20 per axil; Mexico . . . . 11. *G. nudiflora*
8a. Plants armed at the nodes by 4 (less often 2) spines 9
8b. Plants spineless 11
9a. Spines 5–9(–17) mm, aciculate, rigidly erect . . . . 1b. *G. americana** var. *spinosa*
9b. Spines 0.5–3 mm, robust, incurved, spreading or recurved 10
10a. Leaf margin white-cartilaginous; epicalyx corniform growths at the sinus between adjacent sepals; spines strongly recurved, 1–2.5 mm . . . . 5. *G. curvispina*
10b. Leaf margin membranous; epicalyx absent; spines variously recurved, spreading, or incurved,

0.5–3 mm, inconsistently present and unequally developed . . . . 1a. *G. americana** var. *americana*
11a. Epicalyx absent, the sinus between the sepals free of thickened growth; epipodium slender, 2–7.5 mm . . . . 1a. *G. americana** var. *americana*
11b. Epicalyx a continuous flange encircling the exterior of the floral cup at the base of the sepals, or discontinuous as a thickened growth at the sinus between adjacent sepals; epipodium absent or present and stout or slender, 1–6 mm 12
12a. Epicalyx a continuous flange encircling the exterior of the floral cup at the base of the sepals 13
12b. Epicalyx discontinuous as an elongate or corniform growth at the sinus between adjacent sepals, or a thick pocket-like growth at the sinus subtended by a narrowly winged or thickened rib 15
13a. Epipodium slender, 5–6 mm; flowers 14–18 mm; Haiti and Dominican Republic . . . . 3. *G. buchii*
13b. Epipodium absent or stout to 2 mm; flowers 6–12 mm 14
14a. Flowers 11–12 mm; leaves yellow- to gray-green adaxially and abaxially, suborbicular or broadly ovate, 17–52 × 10–40 mm; Haiti . . . . 12. *G. pulchra*
14b. Flowers 6–9 mm; leaves dark green adaxially, paler green abaxially, ovate-oblong or ovate-lanceolate, 20–90 × 7–35 mm; Cuba . . . 7. *G. glabra*
15a. Epicalyx an elongate or corniform growth at the sinus between adjacent sepals; flowers mostly 5 to 12 per axil, loosely umbelliform; leaf margin often undulate; Cuba . . . . 6. *G. ginorioides*
15b. Epicalyx a thick pocket-like lobe at the sinus between adjacent sepals, subtended by a narrow undulate wing or thickened rib; flowers 1 or 2 per axil; leaf margin plane; Haiti . . . . 4. *G. callosa*

1. **Ginoria americana** Jacq., Enum. Syst. Pl. 22. 1760. TYPE: Cuba. "Habitat ad ripas fluviorum rupestres & glareosas in Cuba" (neotype, designated [as lectotype] by Graham, 2005: 301, plate 91 of the protologue). Figures 1, 12.

Subshrubs or shrubs, 1–2(–3.5) m; stems erect or laxly ascending, glabrous or puberulent, tending to wine-red when young, branched; nodes unarmed (variety *americana*) or armed by (2 or)4 spines (variety *americana* and variety *spinosa*), in variety *americana*, the spines ranging from scarcely developed to stout, variously incurved, spreading, or recurved, 0.5–3 mm, in variety *spinosa*, the spines slender, acicular, erect, 5–9(–17) mm. *Leaves* with petioles 0.5–1 mm; blades oblong-lanceolate to narrowly elliptic or linear-oblong, 10–70 × 4–38 mm, thickly membranous, deep green adaxially, paler abaxially, base acute, apex obtuse to acute, margin not cartilaginous and the intramarginal vein present ca. 3 mm inside the margin of larger leaves or merging with the margin on small leaves (variety *americana*), or cartilaginous and lacking intramarginal tissue (variety *spinosa*), secondary veins in 3 to 10 pairs, acutely ascending, tertiary veins obscure. *Inflorescences* racemose, 1 or 2 flowers per axil on the main stem; pedicels 10–30(–40) mm, slender; bracteoles 1–5(–9) mm, linear to spatulate. *Flowers* 6-merous, globose in bud, shallowly campanulate at anthesis, coriaceous, 7–17.5 mm, 5–15 mm diam. at the floral cup margin, abruptly contracted to a slender epipodium 2–7.5 mm; floral cup 3–5 mm, green or green tinged with red, intensely red-purple to dark red after anthesis; sepals 4–5 × 2.5–5 mm, deltate to narrowly deltate, erect to spreading; epicalyx absent; petals 6, orbicular or suborbicular, 7–15 × ca. 9 mm including a claw 0–1 mm, bright rose-purple; stamens 12(to 16), surrounding the base of the ovary, inserted ca. 1.5–3 mm below the sinuses along the margin of a scarcely developed inner tissue layer, exserted beyond the sepals or partially crumpled into the floral cup, filaments 4–7.5 mm, anthers ca. 3 mm; ovary 4- to 5-locular, green turning dark wine-red; style 5–9 mm, exserted. *Capsule* globose, included; seeds 0.9–1.2 × 0.4–0.6 mm, subrectangular to obovoid, slightly bilaterally compressed or prismatic with 3 or 4 poorly defined sides. *Chromosome number*: $2n = 56$ (Tobe et al., 1986; reported as *Ginoria glabra*).

Discussion. *Ginoria americana* is the only 6-merous species (six sepals and petals) that has no epicalyx. Seeds are mostly more rectangular in outline and thicker-coated than the other species but vary, some approaching the type found in *G. curvispina*. Plants also vary greatly in leaf size and shape and numbers of flowers produced. It is the most widely distributed and most common species of the Cuban *Ginoria*. *Ginoria americana* var. *americana* occurs throughout Cuba on rocky islands in streams and along rocky or sandy riverbanks. Plants in these habitats produce dark green, oblong-lanceolate to oblong-linear leaves at the large end of the size range, with full or partial intramarginal venation. Young stems tend to be wine-red, and the shallowly campanulate floral cups become deep wine in color as they mature, in striking contrast to the showy rose-purple petals. The same coloration at maturation has been observed in *G. buchii* and *G. callosa*. Rarely (in cultivation), *G. americana* var. *americana* forms multiflowered brachyblasts to 2 cm. Variety *americana* is mostly unarmed but can produce inconspicuous nodal knobs that sometimes develop unequally into one to four recurved, spreading, or incurved spines (e.g., as in *Graham 1143*, HAC, MO). Spiny and spineless plants of *G. americana* var. *americana* are determined separately in the generic key.

In the vicinity of Santa Clara, province of Villa Clara, and in a few scattered localities in La Habana,

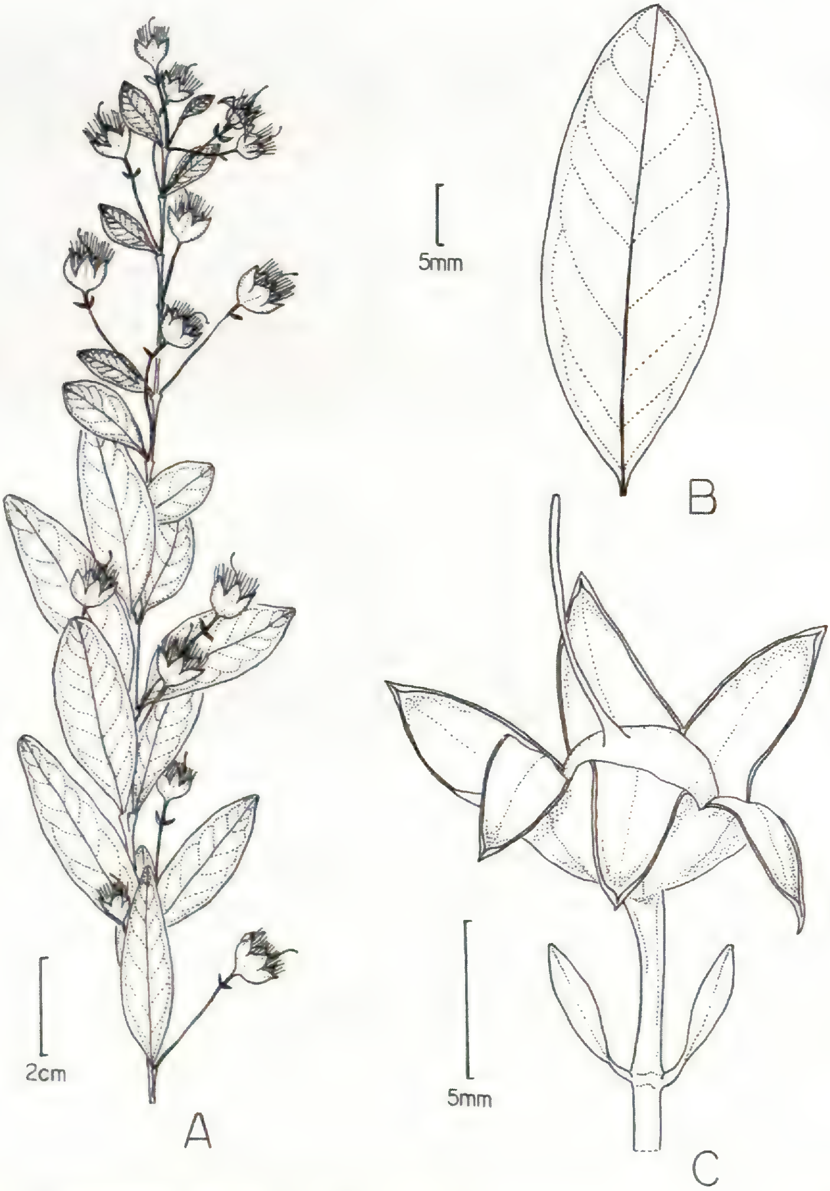

Figure 12. *Ginoria americana* Jacq. var. *americana*. —A. Habit (*Graham 1145*, MO). —B. Leaf, adaxial view (*Ekman 83*, S). —C. Flower (*Ekman 83*, S).

Matanzas, Camagüey, and Cienfuegos provinces, a distinctive, more spiny type of *Ginoria americana* bearing four notably long, slender, erect nodal spines appears in xeric habitats on serpentine soils. Plants with this form are more shrubby with many short branches, have little or no anthocyanic coloration, and the intramarginal vein of the mostly smaller, thicker leaves forms the thickened margin of the leaf. At one site in Santa Clara, I observed spineless, large-leaved *G. americana* var. *americana* growing rooted in a stream at the base of a serpentine bluff and long-spined, small-leaved *G. americana* var. *spinosa* growing immediately above, rooted in cracks of serpentine rock. No intermediate forms were present (pers. obs.; *Graham 1135*, MO). Although the morphological extremes of the varieties are strikingly different, leaf shape and sizes

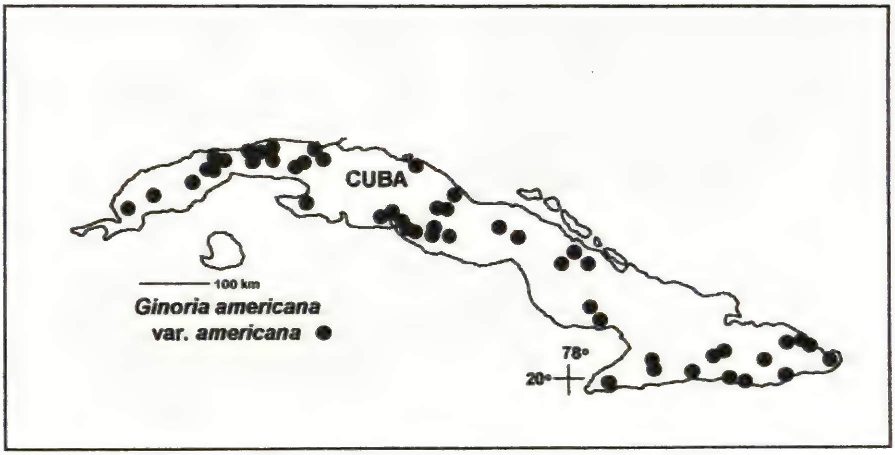

Figure 13. Distribution of *Ginoria americana* Jacq. var. *americana*.

and flower sizes overlap quantitatively. I have come to the same conclusion reached previously by Alain in an annotation on *Wright 2545* (NY) to treat the spiny and spineless types as conspecific, although the relationship between these taxa needs further study. The spiny type is given formal taxonomic recognition at the varietal level here on the basis of the consistent presence of the slender long spines, generally smaller elliptic-oblong leaves and small flowers, and what appears to be an edaphic restriction to dry, primarily serpentine, soils within the broad geographic range of the species.

1a. Ginoria americana var. **americana**. Figures 1, 12.

Juvenile stems green to red, glabrous to densely puberulent; nodes unarmed or some nodes inconspicuously armed by robust spines 0.5–3 mm, the spines incurved, spreading, or recurved, some unequally developed at a node. *Leaves* oblong-lanceolate to narrowly elliptic or linear-oblong, commonly 25–65 × 15–35 mm, intramarginal tissue present, the leaf margin membranous. *Floral cups* 10–17.5 × 8–15 mm, turning wine-red with age. *Chromosome number*: $2n = 56$ (Tobe et al., 1986; reported as *Ginoria glabra*).

Distribution. The autonymic variety is endemic to Cuba, occurring throughout the island in the provinces of Camagüey, Cienfuegos, Ciego de Avila, Ciudad de La Habana, Granma, Guantánamo, La Habana, Holguín, Las Tunas, Matanzas, Pinar del Río, Sancti Spíritus, Santiago de Cuba, and Villa Clara (Fig. 13). It is found along freshwater streams, on sandy or rocky stream margins, and among rocks in flowing rivers from 50–800 m.

Phenology. Plants have been collected in flower beginning in December. They continue to flower and fruit through June. Old fruit often persistent from July to January.

Common names. Clavellina del río, rosa del río (Echevarría & Graham, 2008).

Additional specimens examined. CUBA. s. loc., *Rugel 727* (GOET). **Camagüey:** zona costera, Mpio. Minas, Mar. 1987, *Avila 3028* (HACC); márgenes de un arroyo cercano a San Felipe, Jatibonico, Apr. 1987, *Méndez 3368* (HIPC); alrededores de la Finca La Josefina, El Pilar, Dec. 1984, *Risco & Méndez 2544* (HAC, HAJB, HIPC). **Ciego de Ávila:** at Río Azul along the Carr. Central, 18 km N of Ciego de Avila, Mar. 2003, *Graham 1137* (FTG, HAC, MO). **Cienfuegos:** Sierra del Escambray, Loma del Burro, Nov. 1967, *Bisse & Rojas L. 4706* (HAJB, JE); Guajimico, Mar. 1910, *Britton et al. 6000* (NY); Río Damují, Cienfuegos Bay, Mar. 1911, *Britton et al. 10279* (NY); San Blas, La Veguita, cafetal Buenos Aires, Mar. 1986, *Camacho et al. 691* (HPVC); vic. of Cienaguita, Mar. 1891, *Combs 26* (GH, MO, NY); afluente del Río Hondo, Las Tapias, Nov. 1986, *Expedición del HAC 37366, 37332* (HAC); 8 km S of El Jardín Botánico Cienfuegos in Soledad, 300 m below bridge at Río Arimao, Mar. 2003, *Graham 1145* (FTG, HAC, MO); 4 mi. NE of Soledad, Aug. 1940, *Hodge & Howard 4146* (A, AJBC); Mina Carlota, SE of Cumanayagua, Sierra de San Juan, Arroyo Navarro, *Hodge & Howard 4561* (A, AJBC); San Joaquin, vic. of Soledad, Aug. 1941, *Howard 6245* (GH, NY); San Blas, 8 Mar. 1930, *Hunnewell 11548* (GH); Soledad, Harvard Tropical Garden, Feb. 1926, *Jack 4070* (A, US), Apr. 1926, *Jack 4532* (A, US); Limones, Soledad, Feb. 1927, *Jack 4731* (A); Belmonte, Soledad, arroyo, Apr. 1927, *Jack 5082* (A); Soledad, Limones, Sep. 1927, *Jack 5481* (A, US); Soledad, Limones, Oct. 1927, *Jack 5551* (A); San Blas, La Sierra, Dec. 1928, *Jack 6779* (US); entre San Blás y Matagua, Sierra del Escambray, Sep. 1975, *Meyer 28266* (HAJB); Sierra San Juan, above San Blas, Nov. 1941, *Morton 3975* (US); Trinidad Mtns., Buenos Aires, Feb. 1956, *Morton 10380* (US); Colonia Limones, Ingenio Soledad, Feb. 1903.

Pringle 105 (GH); Belmonte Hill, Soledad, 26 Feb. 1928, *Rehder 1123* (A); San Blas, on hwy. near spring "Puzo del Cura," July 1929, *Salvoza 640* (A); Mina Carlota, SE of Cumanayagua, Mar. 1938, *Senn 196* (US); Soledad vic., Mar. 1926, *Singleton 294* (AJBC); along Hanabanilla River, Trinidad Mtn., July 1950, *Smith 3071* (AJBC); rd. betw. Gavilanes & La Sierra, July 1936, *Smith & Hodgdon 3172* (GH). **Ciudad de La Habana:** Guanabo, Campo Florido, Loma de la Coca, Dec. 1966, *Bisse 645* (HAJB, JE); Río Almendares, Apr. 1914, *Ekman 83* (S); Habana, Dec. 1927, *Lazo 24169* (HAC); Valle de Almendares, Dec. 1908, *León 331* (HAC); Río Marianao, Sep. 1912, *León 3421* (HAC); Arroyo Naranjo, Jan. 1908, *León 486* (HAJB); Río Almendares, Feb. 1889, *Morales 473, 474* (HAC); Calabazar, Nov. 1909, *Ponce 229* (HAC); Calabazar, Jan. 1904, *van Hermann 351* (HAC, NY); near Calabazar, Jan. 1905, *van Hermann 495* (HAC, HAJB, MO, NY, US), *4351* (HAC). **Granma:** Río Yara, Nagua, May 1948, *Acuña 15128* (HAC, HAJB); cultivada en Manzanillo, Nov. 1953, *Acuña 19038* (HAC); Ensenada de Mora, river valley, Mar. 1912, *Britton et al. 12953* (MO, NY, US); Santa Elena, El Pobre, Nov. 1948, *Clemente 6312* (GH, NY, US); Río Buey, Mar. 1943, *Marie-Victorin 60047* (GH); N spur of Sierra Maestra on Río Yao, Oct. 1941, *Morton & Acuña 3847* (US). **Guantánamo:** Baracoa, Mabujabo, across Río Ouabu & SE slope of El Yunque, June 1997, *Axelrod 10318A* (US); Vega de la Palma, alrededores del Río Duaba, Feb. 1979, *Bisse et al. 39689* (HAJB); mesa del Chivo sobre Maisí, Guantánamo, Mar. 1970, *Borhidi et al. 114/3* (HAC); Yateras, July 1928, *Castellanos 97* (HAC); banks of Cañas River, La Clarita, Feb. 1948, *Clemente 5924* (GH); in Río Yateras, Apr. 1889, *Eggers 4583* (A); Baracoa, at edge of Río Macaguanigua, Jan. 1915, *Ekman 4317* (NY, S); Guantánamo ad Yateritas, Dec. 1919, *Ekman 10221* (S, US); Las Ninfas, Dec. 1917, *Hioram 1511* (HAC); vic. of Baracoa, Jan. 1902, *Pollard et al. 39* (GH, MO, NY, US); márgenes del Río Duaba, base de campismo El Yunke, May 1997, *Risco & Romano 9516* (HIPC); prope villam Monte Verde dictam, *Wright 160* (A, GH, GOET, HAC, MO, S). **Holguín:** alrededores del campamento de La Breña, Apr. 1981, *Bisse et al. 44904* (HAJB); márgenes del Río Piloto arriba, Finca La Caridad, Nov. 1954, *Figueiras 1566* (HAJB). **La Habana:** San Antonio de Los Baños, Nov. 1904, *Baker & Donovan 4143* (HAC, NY); Canasí, lomas al NO del Central Elena, Apr. 1979, *Berazaín 23150* (HAJB); Madruga, Apr. 1903, *Shafer 270* (HAC); San Antonio, Apr. 1903, *Shafer s.n.* (HAC); shady brook near asphalt mines, Sep. 1904, *van Hermann 44* (NY); near asphalt mines above Bejucal, Sep. 1904, *van Hermann 1839* (HAC). **Las Tunas:** Guayabal, A. Rodriguez sabana secondaria cercana a la costa, Mar. 1990, *Verdecia & Brull 4030* (IPTH). **Matanzas**: Cantel, Camarioca, June 1976, *Berazaín & González 31967, 31973, 31974, 31979* (HAJB); Yaití, *Martius s.n.* (MO); vic. of Matanzas, rocks in San Juan River, Mar. 1903, *Britton et al. 270* (HAC, NY); Ceiba Mocha, in cuabales towards Canasí, edge of brook, Mar. 1924, *Ekman 18608* (HAC, NY, S, US); Ciénega de Zapata, June 1978, *Groudzinskaya 29196* (HAC); Canimar River, 1849, *Rugel 65* (L, NY). **Pinar del Río:** Pan de Guajaibón, *Acuña 10573* (HAC), Dec. 1936, *10760* (HAC, HAJB); arroyos en Bahía Honda, Mar. 1946, *Acuña et al. 24165* (HAC); Arroyo de Soroa, Jan. 1952, *Acuña & Alain 24167* (HAC); Rio Taco-Taco, Rangel, *Acuña 24168* (HAC); Río de los Puercos, W de la Cajalbana, La Palma, Jan. 1951, *Alain 1737* (GH, HAC, NY, US); San Diego de los Baños, barranco del Río San Diego, Apr. 1976, *Alvarez de Zayas et al. 33466* (HAJB); márgenes del Río San Diego, al N del pueblo, Oct. 1990, *Areces 2136* (MNHNC); Herradura, Sep. 1905, *Baker 2797* (A, GH, HAC, NY, US); Sagua, orillas del arroyo, Nov. 1968, *Bisse & Lippold 10681* (HAJB, JE); La Palma, Loma Peluda de Cajálbana, Sep. 1970, *Bisse 18331* (JE); San Diego de los Baños, valle del Río Los Palacios cerca de Seboruco, Dec. 1979, *Bisse & Lippold 18508* (HAJB, JE); Sumidero, a orillas de Río Frío, Dec. 1978, *Bisse et al. 38900* (HAJB); Potosí, en aguadales de los rocas del río, Feb. 1996, *Bonet 7454* (IPTH); San Diego de Los Baños, Aug.–Sep. 1910, *Britton et al. 6742* (NY, US); vic. of Guane, falls, Río Portales, Mar. 1911, *Britton et al. 9766* (NY); Río Manantiales, N of Candelaria, Feb. 1916, *Britton et al. 14121* (NY); Río San Cristobal, El Brujo, May 1927, *Fors 4367* (HAC); Río Los Portales, El Salto, Guane, Sep. 1987, *Luis et al. 3804* (HIPR); Río Portales, Guane, orillas del río sobre carso, Mar. 1989, *Méndez & Verdecia 1074* (IPTH); Río Portales, base de campismo, Mar. 1989, *Méndez & Verdecia 4514* (HIPC); Santa Cruz to Rangel, Sierra de Los Organos, Nov. 1941, *Morton 4402* (US); Río Portales, Dec. 1911, *Shafer 11201* (A, GH, MO, NY, US); San Gabriel to Santa Mónica, on rocks in Río San Diego, Jan. 1912, *Shafer 11890* (MO, US); Río Los Portales, El Salto, Guane, Sep. 1987, *Urquiola et al. 3804* (HIPR); along camino Aguacate from Bahía Honda to Baños Aguacate, rocks in brook, Dec. 1910, *Wilson 9220* (NY); Río San Miguel below Mal Paso, Dec. 1910, *Wilson 9302* (NY). **Sancti Spíritus:** Sierra del Escambray, a lo largo del sendero de Topes de Collantes hacia el Salto del Caburní, a la orilla de río, June 1993, *Acevedo-Rodríguez et al. 5488* (HAC, US); Topes de Collantes, los bordes de una cañada debajo del acueducto, July 1974, *Areces et al. 25176* (HAJB); orillas del Río Blanco, cerca de Poza Azul, May 1987, *Arias et al. 62072* (HAJB); Río Banao Jaricó, AIP El Naranjal, Lomas de Banao, piedras en el río, Feb. 1994, *Bécquer 755, 781* (HJSS); Sierra del Escambray, Matagua de la Vega, manantial en la carretera de San Blás, Jan. 1967, *Bisse & Duek 1114* (HAJB); Sierra del Escambray, Loma del Burro, Nov. 1967, *Bisse 4706* (JE); Loma Gavilanes (alto del Jobo), Nov. 1979, *Bisse et al. 41140* (HAJB); Trinidad Mtns., Hanabanilla Falls, Mar. 1910, *Britton et al. 4809* (NY); Trinidad, Loma de Zayas, detrás del Campismo Manacal, Dec. 1996, *Calzada et al. 6153* (HPVC); Las Damas, *Cañizares et al. 99* (HJSS); Las Damas, Sep. 1994, *Castañeda 99* (HJSS); Lomas de Banao, Feb. 1920, *Luna 219* (NY); Guamuhaya, márgenes del Río Las Cañas en el Campismo Manacal, *Noa et al. 6409* (HPVC); vic. of Sancti Spíritus in river, Feb. 1912, *Shafer 12160* (A, NY, US). **Santiago de Cuba:** Sierra Maestra, cañada del Río Magdalena, May 1971, *Bisse & Lippold 19501* (HAJB); Río Guamá, Apr. 1944, *Clemente 2410* (HAC); Chirivico, Apr. 1944, *Clemente & Chrysogone 3410* (HAC, NY); La Clarita, Feb. 1948, *Clemente & Bartolomé 5924* (HAC); Finca Santa Elena, El Cobre, Nov. 1948, *Clemente 6312* (HAC); Bayate ad marg. fluminis Cauto, Sep. 1914, *Ekman 2790* (S); Bayate ad marginem fluminis Jagua, Mar. 1917, *Ekman 8579* (S); cercanías de la represa La Firmesa, May 1952, *Figueiras 521* (HAC, HAJB); forest about Paso Estancia, near water in arroyo, Apr. 1909, *Shafer 1579* (NY, US); Sevilla Estate, near Santiago, Sep. 1906, *Taylor 170, 177* (NY). **Villa Clara:** Finca Guadalupe, Placetas, Feb. 1952, *Acuña 17512* (HAC, NY); cuabales entre Santa Clara y Falcón, Nov. 1968, *Bisse & Lippold 9796* (JE); Hoyo de Manicaragua, Feb. 1910, *Britton et al. 4669* (NY); palm barren, Santa Clara, Apr. 1912, *Britton & Cowell 13307* (NY); Sagua la Grande, camino que va del IPUEC "Miguel Diosdado Pérez Pimentel" a la Presa Alacranes, Nov. 1998, *Duarte 7007* (HPVC); Caibarién, lugares húmedos, Dec. 1919, *Fernando 114* (GH); Caibarién, July 1920, *Fernando 369* (HAC); sabana al E de Santa Clara, June 1932, *León 15631* (HAC); Placetas, Cerro

Caicaje al Sur del Olivar, Apr. 1987, *Noa & Castañeda 1539-A* (HPVC); loma cerca de Arroyo Saguito, Reserva Agabama, Cubanacán, June 1987, *Pérez 243* (MNHNC). **Cultivated:** U.S.A. Florida: Fairchild Garden #1753C, plot 33, from University of Havana Botanical Garden via *Keim 29*, Mar. 1982, *A. Bird s.n.* (MO), *Gillis 7963* (MO). Locality unknown: *Ramon de la Sagra s.n.* (A).

1b. Ginoria americana var. **spinosa** (Griseb.) S. A. Graham, var. & stat. nov. Basionym: *Ginoria spinosa* Griseb., Cat. Pl. Cub. 106. 1866. TYPE: Cuba. "Cuba or.," *C. Wright 2545* p.p. (=*1200*) (holotype, GOET!; isotypes [restricted to the branches so annotated in this mixed collection], GH!, HAC!, MO!, NY!, S [2]!). Figure 14.

Juvenile stems reddish brown, glabrous or sparsely pubescent; nodes conspicuously armed by 4 brown, slender, aciculate, rigidly erect, spines 5–9(–17) mm. *Leaves* elliptic-oblong, 10–25 × 5–10 mm, intramarginal tissue absent, the intramarginal vein forming a cartilaginous leaf margin. *Floral cups* 7–12 × 5–10 mm. *Chromosome number*: unknown.

Distribution. The variety is endemic to Cuba, in the provinces of Camagüey, Cienfuegos, La Habana, Matanzas, and Villa Clara on dry, rocky serpentine sites from 50–500 m (Fig. 15).

Phenology. Plants have been collected in flower and fruit from March through June.

Common name. Clavellina espinosa (León & Alain, 1953; Roig y Mesa, 1963).

Discussion. Grisebach described *Ginoria spinosa* from the single sheet of *Wright 2545* at GOET, without knowledge that *Wright 2545* is a mixed collection of two spine-bearing species. The holotype is exclusively *G. spinosa*. It lacks a printed label but bears a handwritten one with the Gray and Wright numbers, the species name, a brief diagnosis, and "Cuba occ. Wr 1863" in Grisebach's hand. Other sheets of this number include both *G. americana* var. *spinosa* and *G. curvispina* (GH, HAC, MO, S [2]), only *G. americana* var. *spinosa* (NY-Torrey), or only *G. curvispina* (A, US). Field labels of *Wright 2545* (GH) indicate plants were collected in: Villa Clara; Sancti Spíritus/Villa Clara at Río Agabama on 18 January; along rivulets near Villa Clara on 19 January; in Pinar del Río at San Cristobál on 7 and 17 April; and in savannas and along margins of streams at Charco del Toro on April 17. The collections made in Pinar del Río are *G. curvispina*. Those from the vicinity of Villa Clara include *G. spinosa* and *G. curvispina* (the other species in the mixed collections of *Wright 2545* [= *1200*]).

Additional specimens examined. CUBA. **Camagüey:** Río Los Montesitos, May 1985, *Méndez & Elenevsky 8036* (HIPC). **Cienfuegos:** San Blas, Veguitas, cafetal Buenos Aires, May 1984, *Noa 562* (HPVC). **La Habana:** Canasí, arroyo grande cerca del central Elena, July 1970, *Bisse & Lippold 17523* (HAJB, JE); arroyo en Loma de Galindo, Aug. 1969, *Mision de Fitoquimicos 27081* (HAC). **Matanzas:** in cuabales NW of Pan de Matanzas, SE of Canasí, May 1923, *Ekman 16517* (NY, S). **Villa Clara:** Santa Clara, Cerro de Pelo de Malo, May 1974, *Alfonso et al. 131, 186* (HPVC); cuabal en la orilla de la carretera central a la entrada oeste de Santa Clara, Feb. 1968, *Bisse 5006* (HAJB, JE); Lomas de Agabama, Aug. 1977, *Bisse et al. 35183* (HAJB); palm barren, city of Santa Clara, Mar. 1910, *Britton et al. 6093* (NY); along brook near Loma Cruz, Mar. 1911, *Britton et al. 10243* (NY); palm barren, Santa Clara, Apr. 1912, *Britton & Cowell 13308* (NY, US); Santa Clara City, June 1922, *Ekman 14051* (S); camino de Manicaragua, Aug. 1958, *Glassman & Acuña 20709* (HAC); Santa Clara, El Playazo, Area Protegida Cubanacán, a 1 km del restaurante "La Parrillada" en el Centro Recreativo Arco Iris, Mar. 2003, *Graham 1135* (FTG, HAC, MO); rd. from Santa Clara to Manicaragua, 4–8 km S of Santa Clara, serpentine barrens, June 1955, *Harvard Course in Tropical Botany 121* (GH, NY); 6 km W of Santa Clara, *Harvard Course in Tropical Botany 875* (GH); 10 km S of Santa Clara, *Howard 121* (AJBC); Trinidad Mtns., 10 km W of Santa Clara, June–Aug. 1941, *Howard 5063* (GH, NY, S, US); El Playazo, June 1998, *Méndez et al. 10019* (HIPC); Santa Clara, alrededores de la Presa Gramal, Oct. 1980, *Noa 306* (HPVC); Santa Clara, La Hoya, cuabal, May 1983, *Noa et al. 470* (HPVC); frente a la entradad del aeropuerto, bosque de galería, May 2001, *Noa & Méndez 7373* (HPVC); near Santa Clara in serpentine savanna, July 1950, *Smith 3109* (AJBC); rocky bed and banks of river 10 km E of Santa Clara, July 1936, *Smith & Hodgdon 3204* (GH, NY, S, US).

2. Ginoria arborea Britton, Bull. Torrey Bot. Club 39: 13. 1912. TYPE: Cuba. "Thicket, Leeward Point, United States Naval Station, Guantánamo Bay, Cuba, March 1909," *N. L. Britton 2217* (lectotype, designated by Graham, 2005: 301, NY 84338!; isotypes, NY 84337!, US!). Figure 16.

Tall shrubs or small trees to 8 m, ca. 2.5 dm DBH; stems with short terminal branches, glabrous; nodes armed by 4 spines 1–2 mm long, the spines enlarged at the base, horn-like, recurved to spreading. *Leaves* often crowded at the tips of the branches, sessile; blades linear-oblong to lanceolate or infrequently obovate, 10–40 × 3–16 mm, commonly ca. 20 × 8 mm, coriaceous, the surfaces varnished by resin, shining, bright green adaxially, green abaxially, base acute or narrowly attenuate, apex obtuse, mucronate or retuse, margin slightly cartilaginous, intramarginal vein present, 0.3–0.5 mm inside the margin at widest leaf diameter, secondary veins in 3 to 5(to 8) pairs, acutely ascending, tertiary veins slender, visible abaxially. *Inflorescences* 1(to 3)-flowered highly reduced brachyblasts, some flowers also solitary in the axils on vegetative shoots; pedicels 9–12 mm, slender, lax; bracteoles to 1 mm, narrowly linear. *Flowers* 4-merous, globose in bud, shallowly campanulate at anthesis, thickly coriaceous, 4–5 mm, ca. 3 mm diam.

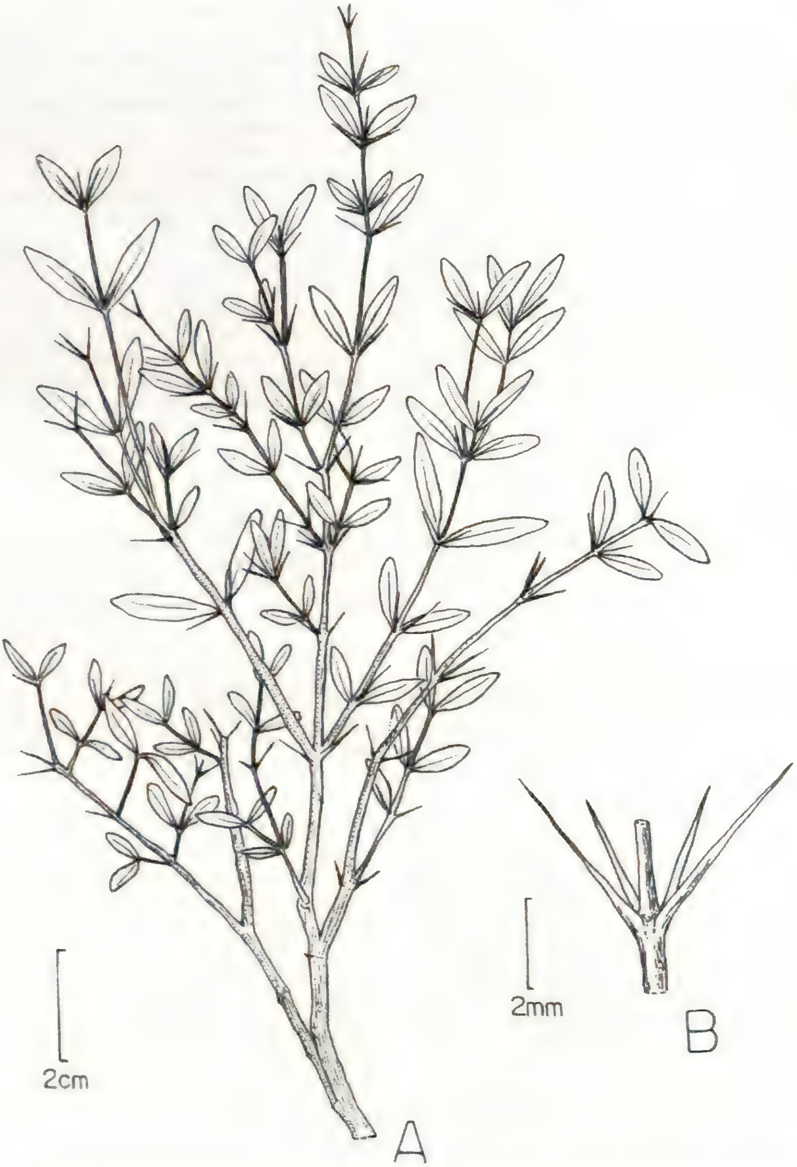

Figure 14. *Ginoria americana* var. *spinosa* (Griseb.) S. A. Graham. —A. Habit. —B. Node with aciculate spines. A, B from *Graham 1135* (MO).

at the floral cup margin, scarcely contracted to a stout epipodium 0.5–1 mm; floral cup 0.5–1 mm, green; sepals 2.7–3(–4) × 1.5–1.7 mm, narrowly deltate, erect; epicalyx absent; petals 4, broadly obovate, not clawed, 2–4 × 0.5–1 mm, scarcely exceeding the sepals, white, the margins erose above the middle; stamens 12 to 14, inserted ca. 1 mm below the sinuses along distal margin of the inner tissue layer, well-exserted beyond the sepals, filaments 3.5–5(–7) mm, anthers ca. 1 mm; ovary 3- to 4-locular, green; style ca. 6 mm, exserted. *Capsule* ovoid, included; seeds 1.4–1.5 × 0.4–0.5 mm, compressed, concave-convex, obovate-oblong-elliptic.

Distribution. *Ginoria arborea* is endemic to Cuba, in the provinces of Guantánamo and Santiago de Cuba (Fig. 17). It grows in thickets, on dry hills, and on coral reefs from 0–400 m.

Phenology. The species flowers primarily from February to May. It has been collected in old fruit in

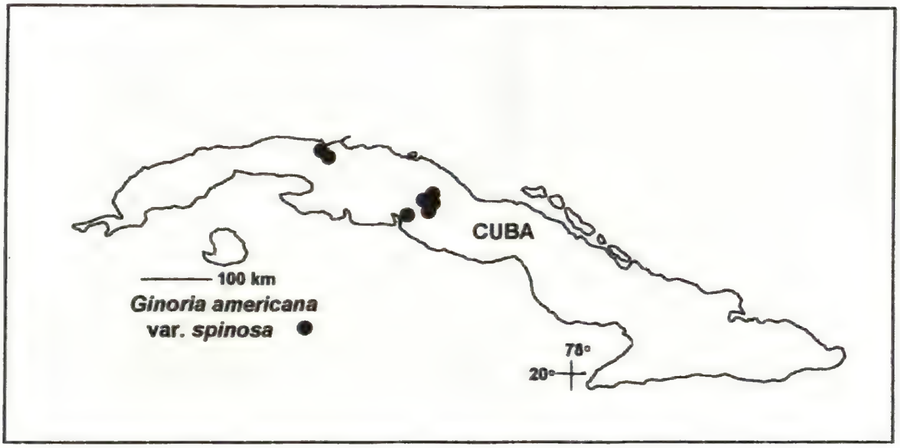

Figure 15. Distribution of *Ginoria americana* var. *spinosa* (Griseb.) S. A. Graham.

November (*Ekman 15780*, NY) and in new fruit in March (*N. L. Britton 2217*, NY).

Common names. Granado, jaspe (Roig y Mesa, 1963).

Discussion. *Ginoria arborea*, an apparently rare or at least rarely collected species in Cuba, is most similar to *G. koehneana*. Both have flowers that are thickly coriaceous, 4-merous, have inconspicuous white petals, and are among the smallest in the genus. However, whereas the floral epipodium is stout and scarcely contracted in *G. arborea*, it is slender and distinctly contracted below the floral cup in *G. koehneana*. *Ginoria arborea* is a tree to 8 m tall; *G. koehneana* is currently known as a large shrub or small tree to 4 m. The species bear similar spines (not scored for *G. arborea* in Graham, 2002). Leaves of *G. arborea* vary widely in size from one plant to another but are smaller and more linear-oblong than the mostly obovate-suborbicular leaves of *G. koehneana*. In addition, leaves of *G. arborea* have three to five(to eight) prominent secondary vein pairs, and the adaxial leaf surface is coated with a shining resin. In *G. koehneana*, leaves have secondary veins in pairs of eight to 10, dense tertiary venation, and the adaxial leaf surface is free of exudate. The species grow in similar coastal habitats on rocky limestone soils in eastern Cuba, although *G. arborea* is restricted to the southeastern coast and *G. koehneana* is found only on the northern coast with the exception of one collection from interior Guantánamo near San Germán. Floral morphological similarity, geographic proximity in eastern Cuba, and morphological cladistic analysis support a sister relationship. Few flowering specimens of either species have been collected. *Ginoria arborea* especially needs to be relocated, and fertile collections of both species need to be made to better understand the species' variation and relationship.

Additional specimens examined. CUBA. **Guantánamo:** lomas al E del Abra de Mariana (Siguato), 5 km al NO de San Antonio del Sur, May 1980, *Alvarez de Zayas et al. 43136* (HAJB); San Antonio del Sur, 4 km ONO del pueblo, Feb. 1976, *Areces et al. 29964* (HAJB, JE); San Antonio del Sur, 4 km al ONO del pueblo, Feb. 1976, *Areces et al. 31375* (HAC); monte seco de Baitiquirí por el camino a la mina del Yeso, May 1968, *Bisse 7727* (HAJB, JE); meseta cerca de Baitiquirí, monte seco, Nov. 1968, *Bisse 10183* (HAJB, JE); Baitiquirí, en el camino a la Mina del Yeso, monte seco, Apr. 1972, *Bisse 21769* (HAJB, JE); alrededores de Tortuguilla, manigua costera, Apr. 1972, *Bisse 21830* (HAJB, JE); lomas al E del Abra de Mariana, Jan. 1977, *Bisse et al. 33974* (HAJB); Abra de Mariana, loma al O del barranco, Feb. 1978, *Bisse et al. 36577* (HAJB); Abra de Mariana, loma al E del Abra, Feb. 1979, *Bisse et al. 39076* (HAJB); loma al N de la Chivera, Feb. 1979, *Bisse et al. 39305* (HAJB); San Antonio del Sur, lomas al este del Abra de Mariana, Jan. 1977, *Bisse et al. 39471* (HAC); on the shore, Nov. 1922, *Ekman 15780* (NY, S, US). **Santiago de Cuba:** Siboney, manigua costera cerca de la Playa Berraco, Apr. 1969, *Bisse 14570* (HAJB, JE); Daiquirí, in thickets on coral reef, Nov. 1916, *Ekman 8363* (NY, S, US).

3. **Ginoria buchii** (Urb.) S. A. Graham, comb. nov. Basionym: *Haitia buchii* Urb., Feddes Repert. Spec. Nov. Regni Veg. 16: 141. 1919. TYPE: Haiti. "In montibus prope Jacmel in praeruptis siccis 300 m, June 1916 flor.," *W. Buch 1181* (lectotype, designated by Graham, 2005: 302, GH!). Figures 1, 18.

Slender shrubs to 3 m; stems with branches of the season somewhat compressed, faintly 2-angled; nodes unarmed. *Leaves* with petioles 3–4 mm; blades narrowly ovate to ovate, 50–130 × 30–65 mm, typically ca. 75 × 35 mm, chartaceous, glabrous, dark green adaxially and abaxially, base rounded,

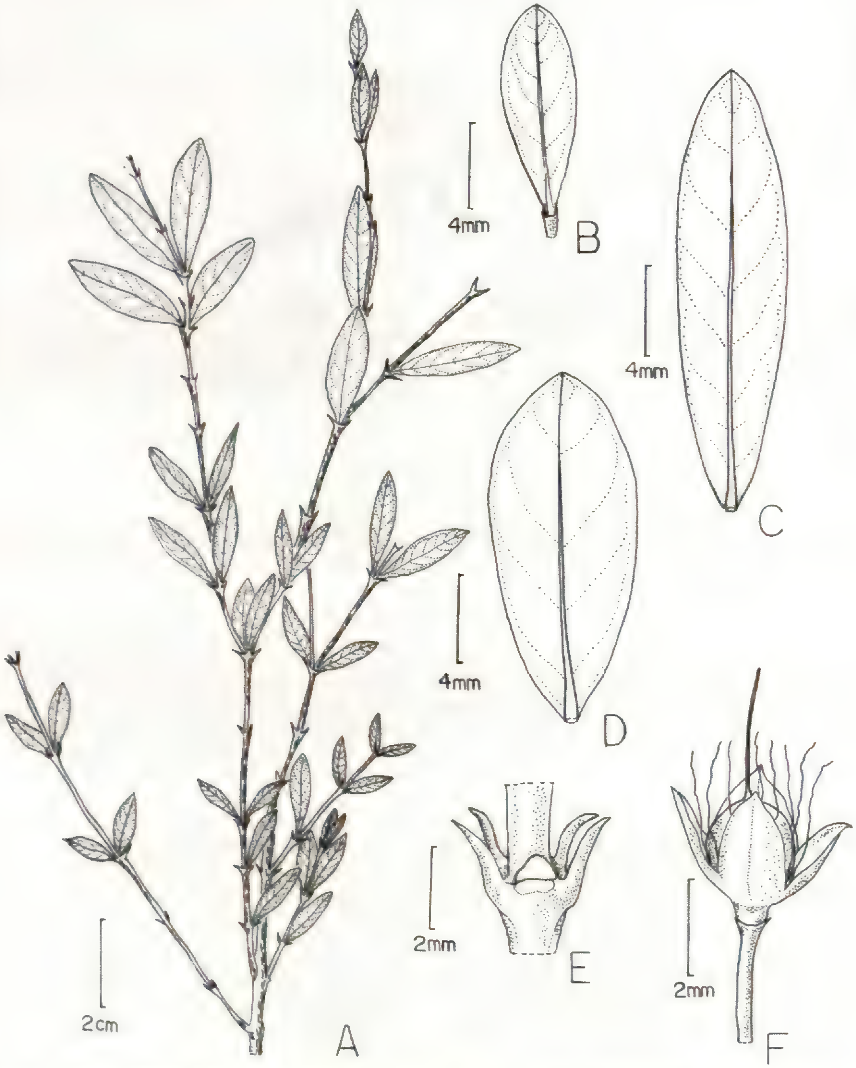

Figure 16. *Ginoria arborea* Britton. —A. Habit (*Bisse 21769*, JE). —B. Leaf, abaxial view (*Ekman 8363*, S). —C. Leaf, abaxial view (*N. L. Britton 2217*, NY). —D. Leaf, abaxial view (*Ekman 8363*, S). —E. Node with four horn-shaped spines (*Bisse 21769*, JE). —F. Flower (*Ekman 15780*, S).

rarely acute, apex acute or short-acuminate, margin membranous, intramarginal vein present, 1–3 mm inside the margin at widest leaf diameter, secondary veins in 8 to 20 pairs, nearly horizontal, shallowly ascending, tertiary veins moderately visible, reticulate. *Inflorescences* 1- to 3(to 6)-flowered highly reduced brachyblasts, some flowers also solitary in the axils of the previous season's leaves; pedicels (18–) 20–30 mm, slender, lax; bracteoles 0.7–1.5 mm, ovate. *Flowers* 6-merous, subglobose in bud, shallowly campanulate at anthesis, coriaceous, 14–18 mm, 10 mm diam. at the floral cup margin, abruptly contracting to a slender epipodium 5–6 mm long; floral cup 4.5–6 mm, green, turning wine-red within; sepals 4.5–6 × 5–6 mm, the apex acuminate-deltate, 0.5–0.8 mm, ultimately deflexed, the sepals spreading to slightly deflexed in fruit; epicalyx an undulating flange encircling the exterior of the floral cup at base of the sepals, ca. 1 mm wide at the sinuses, narrowing to 0.5 mm between sinuses; petals 6, obovate, 12–18 × 10–14 mm, not clawed, rose-purple; stamens 34 to 40, inserted 1.5–2 mm below the sinuses of the sepals on the distal edge of the narrowly free margin of the inner tissue layer, well-exserted, filaments 7–10 mm, anthers ca. 4 mm; ovary 6-locular, slightly depressed, 6-sulcate, turning dark red; style 10–14 mm, exserted.

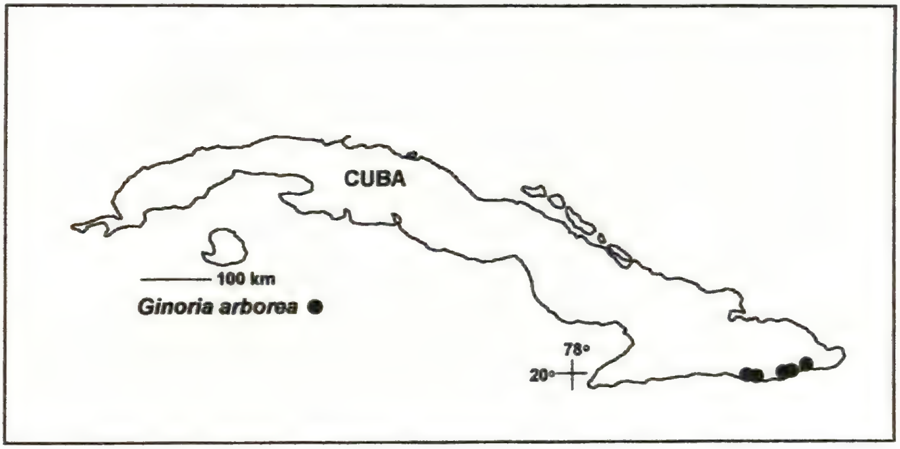

Figure 17. Distribution of *Ginoria arborea* Britton.

Capsule globose, included, reaching the margin of the floral cup; seeds ca. 1 × 0.2 mm, compressed, concave-convex, oblong.

Distribution. *Ginoria buchii* is endemic to Hispaniola, growing in Haiti and the western Dominican Republic, on steep limestone cliffs from 300–700 m (Fig. 19).

Phenology. Flowering occurs from March through June, with mature fruits beginning in April.

Discussion. Possibly the most beautiful of the *Ginoria* species and one of the most beautiful endemic shrubs of Hispaniola, *G. buchii* has large, dark green shining leaves and multi-staminate flowers resembling wild roses (Fig. 1). The undulating flange (the epicalyx) encircling the 6-merous floral cup and slender elongate epipodium at the base of the floral cup are diagnostic for the species. *Ginoria glabra*, also with 6-merous flowers and an encircling epicalyx, differs by a short, stout epipodium or the epipodium missing and by leaves with specialized, thickened yellow veins. Botanists from the Jardín Botánico in Santo Domingo have sought on several occasions without success to relocate the species at Río Arriba del Norte, where it was last collected in 1969. A dam at Sabaneta to the south has turned part of this area where it joins the Río San Juan into a reservoir (T. Zanoni, pers. comm.). Liogier (pers. comm.) remembers his collection was made above Río Arriba del Norte on the slopes leading to the mountain crest. Liogier (1986) refers to an additional collection from Haiti, "Grand Goave, Thomazeau," without reference to a collector.

Additional specimens examined. DOMINICAN REPUBLIC. **San Juan:** in ravine of Río Arriba del Norte, N of Sabaneta which is N of San Juan, Apr. 1969, *Liogier 14693* (GH, NY). HAITI. **Ouest:** Massif de Matheux, Grand-Bois, rd. Thomazeau to Cornillon, in gorge de la Gascogne, steep limestone cliffs, Mar. 1926, *Ekman 5676* (GH, MO, S, US). **Sud:** Massif de la Hotte, eastern group, Grand-Goâve, Trouin, steep cliffs at Rivière Bras-Gauche, Apr. 1926, *Ekman 5942* (GH, S).

4. Ginoria callosa O. C. Schmidt, Ark. Bot. 21A(5): 17. 1927. TYPE: Haiti. "Massif du Nord, prope Port-de-Paix, in cacumine montis Haut-Piton, ad marginem silvae declivium orientalium 1200 m alt., Aug. 1925 flor," *E. L. Ekman 4619* (lectotype, designated by Graham, 2005: 301, NY!; isotypes, A!, C not seen, EHH not seen, GH!, LL!, MO!, NY!, S [2]!, US [2]!). Figure 20.

Small trees to 6 m; stems with many short terminal branches, glabrous; nodes unarmed. *Leaves* crowded at the tips of the branches, petioles 1–4(–7) mm; blades broadly oblong-elliptic, less often orbicular to oblong or obovate, 18–48(–75) × 10–28(–40) mm, thickly membranous to coriaceous, shining, green adaxially, yellow-green abaxially, base attentuate, apex rounded with a mucronate tip, margin plane, slightly inrolled, intramarginal vein present, ca. 0.5 mm inside the margin at widest leaf diameter, midvein prominent, secondary veins in 7 to 10(to 14) pairs, ascending, tertiary venation thickened, pale yellow, coarsely reticulate with large areolae. *Inflorescences* 1- or 2-flowered highly reduced brachyblasts; pedicels 12–23 mm, sturdy, erect; bracteoles 2–3 mm, ovate-suborbicular. *Flowers* 6-merous, globose in bud, shallowly campanulate at anthesis, thickly coriaceous, 8.5–11 mm, 6.5–10 mm diam. at the floral cup margin, epipodium absent, the base of the flower immediately subtended by bracteoles; floral cup 5–6 mm, green, turning wine-red within; sepals 3.5–5 ×

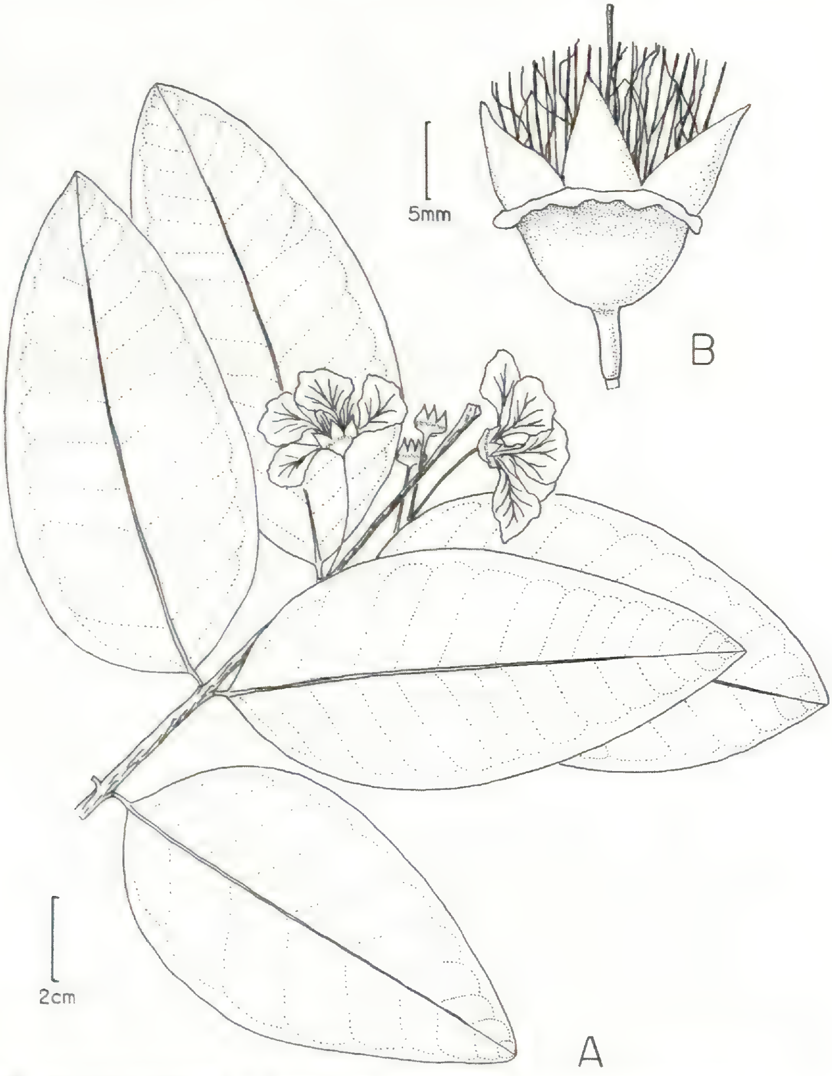

Figure 18. *Ginoria buchii* (Urb.) S. A. Graham. —A. Habit. —B. Flower. A, B from *Ekman 5942* (S).

2.7–4 mm, narrowly deltate, semierect to erect at anthesis, spreading in fruit; epicalyx a thickened pocket-like growth, ca. 2 mm wide at the sinus between adjacent sepals, extending below each sinus along the vein to the base of the floral cup as a narrow undulate wing or thickened rib 1–1.5 mm wide; petals 6, obovate, 14–20 × 11–15 mm, deep rose-purple, becoming paler with age; stamens 30 or 31, inserted ca. 2 mm below the sinuses on the distal edge of the narrowly free margin of the inner tissue layer, exserted, filaments ca. 7 mm, anthers 1–1.5 mm; ovary 3- to 6-locular, turning wine-red; style 10–15 mm, exserted. *Capsule* globose, depressed, included; seeds ca. 0.9 × 0.2 mm, compressed, obovate.

Distribution. *Ginoria callosa* is endemic to Haiti and is known only from the type area of Haut-Piton at the top of the mountain on the eastern slope at 1205 m (Fig. 19).

Phenology. Flowering probably begins in June; flowering specimens have been collected in August. Mature fruits are present in September.

Common name. Cuaresmilla espinosa (Roig y Mesa, 1963).

Discussion. *Ginoria callosa* is a well-defined species with coarsely reticulate, yellowish-veined leaves that are crowded at the tips of the stem and a unique epicalyx consisting of a large pocketed lobe at each sinus that continues as a thickened rib or narrow

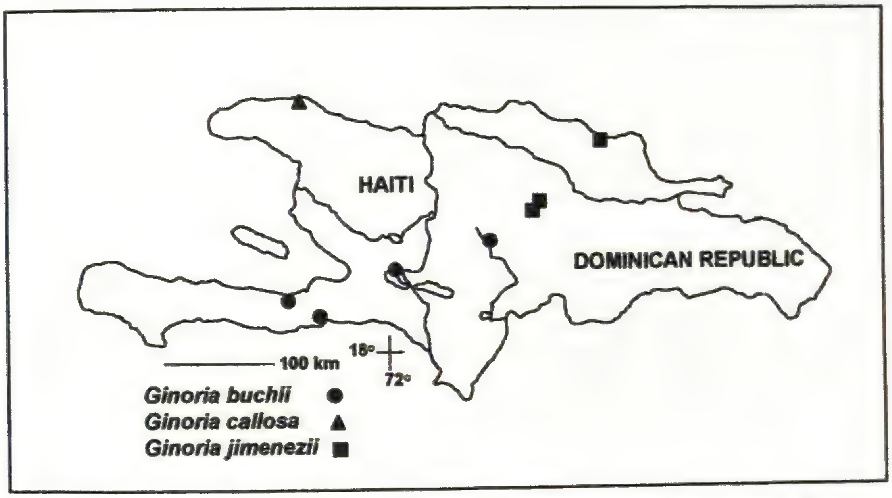

Figure 19. Distribution of *Ginoria buchii* (Urb.) S. A. Graham, *G. callosa* O. C. Schmidt, and *G. jimenezii* Alain on Hispaniola.

wing downward along the vein to the base of the floral cup. The bud, viewed from the apex, is scalloped in outline due to the extended pocket-like epicalyx segments. Ekman, collecting on the northwestern coast of Haiti in 1925, found the species common at the edge of the forest at the type locality slightly southeast of Port-de-Paix. It apparently has not been collected since.

Additional specimens examined. HAITI. **Nord-Ouest:** Massif du Nord, Port-de-Paix, Haut-Piton, top of the mtn., on the old fort, 1205 m, Apr. 1925, *Ekman 3722* (S); 20 Sep. 1925 [fruit], *Ekman 4870* (LL, MO, S).

5. Ginoria curvispina Koehne, Bot. Jahrb. Syst. 3: 349. 1882. TYPE: Cuba. *C. Wright 2545* p.p. (= *1200*) (lectotype, designated by Graham, 2005: 301, MO!; isotypes [restricted to the branches so annotated], GH!, HAC!, MO!, NY!, S [2]!, US!). Figure 21.

Ginoria parviflora Urb., Feddes Repert. Spec. Nov. Regni Veg. 18: 20. 1922. TYPE: Cuba. Camagüey: "prope Camagüey in savannis solo humido, m. April. flor.," [2–7 Apr. 1912], *N. L. Britton, E. G. Britton & J. F. Cowell 13148* (lectotype, designated by Graham, 2005: 302, NY!; isotype, US!).

Ginoria microphylla O. C. Schmidt, Feddes Repert. Spec. Nov. Regni Veg. 24: 78. 1927. TYPE: Cuba. Holguín: "Antilla, in silva litorali, solo calcareo, 20. 5. 1916," *E. L. Ekman 7325* (lectotype, designated by Graham, 2005: 302, NY!; isotype, S!).

Shrubs 1–5 m; stems glabrous; nodes armed by (2)4 robust, strongly recurved spines 1–2.5 mm long, the spines horn-like, yellow, turning brown with age. *Leaves* sessile or petioles to 1 mm; blades narrowly lanceolate-oblong, narrowly elliptic to linear, or infrequently suborbicular, 3–60 × 2–15 mm, often much smaller in the inflorescence than on the main stem, coriaceous and shining adaxially, opaque abaxially, base acute to rounded, apex obtuse and apiculate, acute on linear leaves, margin white-cartilaginous, formed by the intramarginal vein, secondary veins in 6 to 10 pairs, sharply ascending, tertiary veins obscure. *Inflorescences* 1- to 3(to 8)-flowered brachyblasts, flowers also solitary in the axils of the main stem leaves; pedicels 10–23 mm, slender; bracteoles 1–2 mm, linear or filiform. *Flowers* 6-merous, subglobose in bud, campanulate at anthesis, membranous, 4.5–8.5(–10) mm, 4–7 mm diam. at the floral cup margin, contracting to a short, slender epipodium 0.5–1.5(–3) mm long; floral cup 2–3 mm, green, often turning wine-red within; sepals 2.5–3 × 2–2.5 mm, deltate to narrowly deltate, erect to spreading at anthesis; epicalyx corniform growths at the sinus between adjacent sepals, 0.3–0.5 mm; petals 6, suborbicular to broadly ovate with an erose, frilly margin, 5–10 × 5–9 mm including a claw 0.5–2 mm, pale to medium purple; stamens (12 to)14 to 18(to 25), surrounding the base of the ovary, inserted 2–2.5 mm below the sinuses along the margin of scarcely developed inner tissue layer, exserted, 6 antesepalous stamens inserted singly, the antepetalous stamens single or if proliferated, then doubled or tripled at the insertion point, inner tissue layer scarcely developed, filaments 4.5–7 mm, anthers ca. 1 mm; ovary 3- to 5-locular, turning wine-red with age; style 9–10 mm, exserted. *Capsule* globose, reaching the apex of the sepals at maturity; seeds ca. 1.7 × 0.5 mm, compressed, obovate to oblong-elliptic.

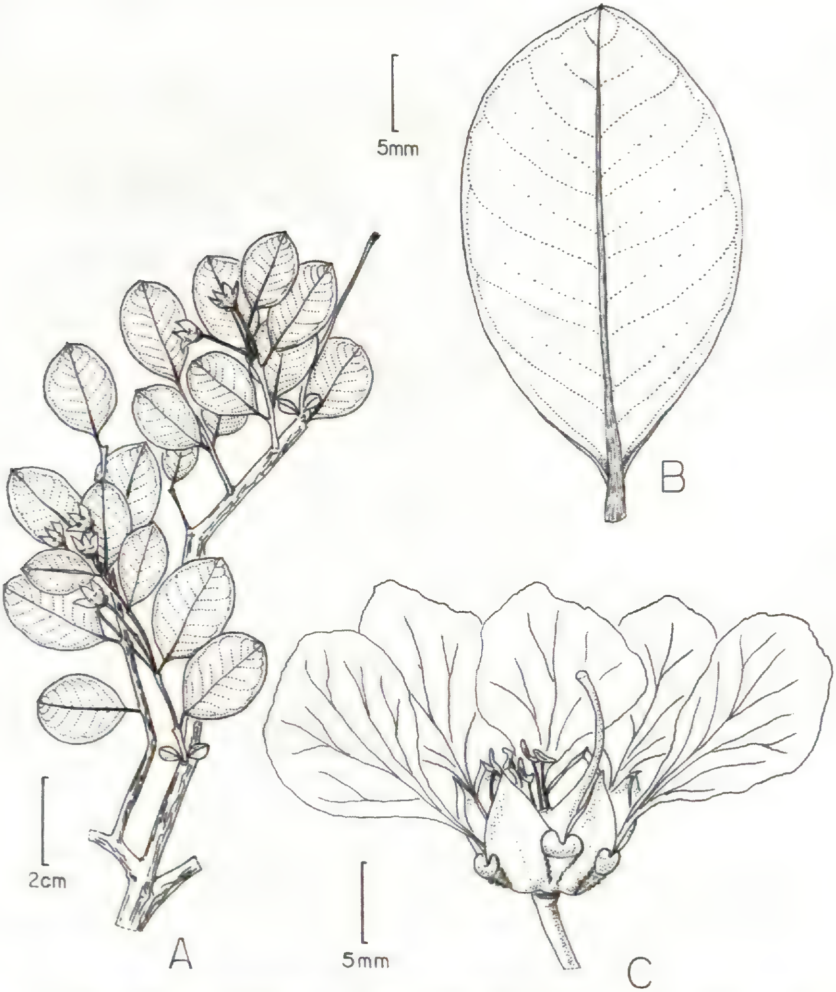

Figure 20. *Ginoria callosa* O. C. Schmidt. —A. Habit. —B. Leaf, abaxial view. —C. Flower. A–C from *Ekman 4619* (S).

Distribution. *Ginoria curvispina* is endemic to Cuba, occurring primarily in the provinces of Camagüey and Las Tunas, with a few scattered localities in Cienfuegos, Holguín, Matanzas, Villa Clara, and Pinar del Río (Fig. 22). It is found on serpentine and lateritic soils in coastal and subcoastal habitats, in semideciduous mesophyllous to xerophyllous thickets, spiny matorral, and in anthropogenic, periodically inundated, palm savannas from 0–100 m.

Phenology. Flowering and fruiting are primarily from February to June.

Common name. Cuaresmilla espinosa (Roig y Mesa, 1963).

Discussion. *Ginoria curvispina* is a straggling shrub with remarkably variable leaf shape and size, flower size, and stamen number. Leaves on a single branch may be suborbicular with an apiculate tip to narrowly linear with an acute tip, and leaves of the main stem are often three times larger than those of the short branches. Stamens vary from 12 to 25 on flowers of a single plant. Consistent characteristics of the species are the thickened cartilaginous margin of the leaves, the presence of four stout, horny, deflexed nodal spines, and the corniform, deflexed growths forming the epicalyx.

The type specimen of *Ginoria curvispina* Koehne at B was cited by Koehne as *Wright 2545* p.p. because some of the other sheets of the same number were mixtures of *G. curvispina* and *G. americana* var. *spinosa* (*G. spinosa* Griseb.). Grisebach based *G. spinosa* on the same Wright number, but the specimen he studied at GOET was exclusively *G. spinosa*. Urban

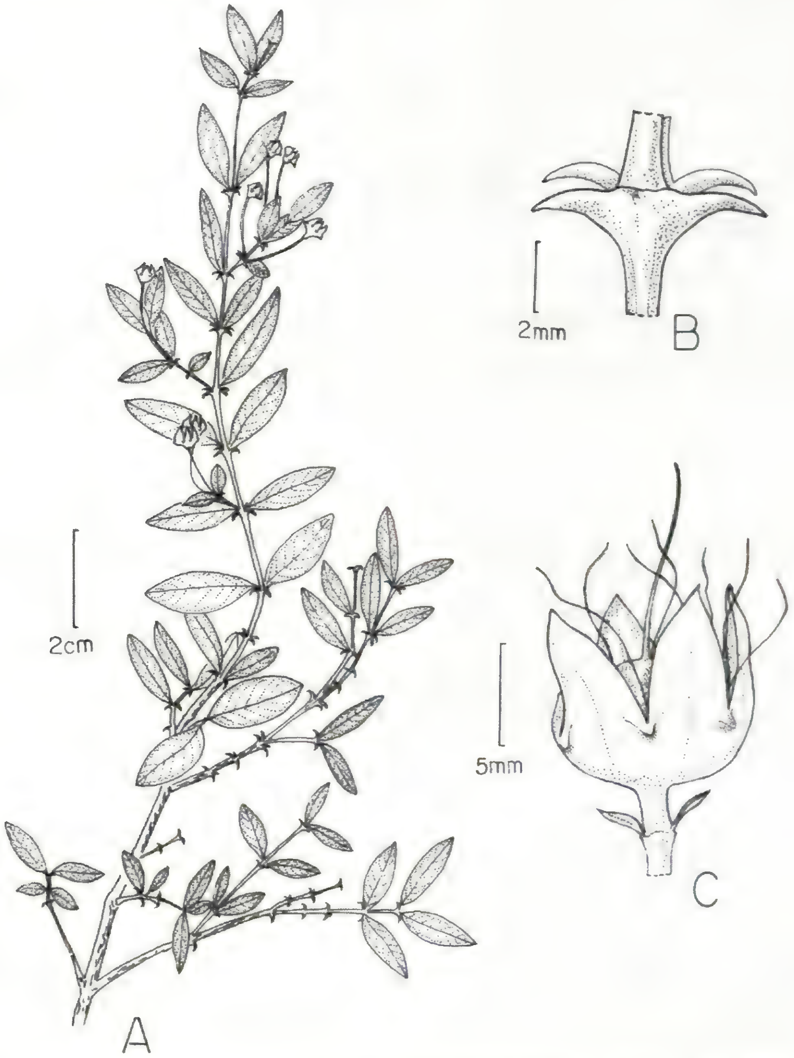

Figure 21. *Ginoria curvispina* Koehne. —A. Habit. —B. Node with four spines. —C. Flower. A–C from *Ekman 17006* (S).

regarded *G. parviflora* as closely allied to *G. curvispina* but distinct in having ovate-oblong or oblong-linear leaves, as opposed to lanceolate-oblong leaves in *G. curvispina*, and flowers half as large with fewer stamens (14 to 15 stamens). Schmidt described *G. microphylla* as having smaller leaves (3–12 × 2.5–4 mm) and smaller flowers (ca. 4 mm long) with fewer stamens (ca. 12) than *G. curvispina*. More extensive collections of *G. curvispina* now demonstrate a much greater range of morphological variation and size that erases these differences among the species. Lacking any other characters to separate *G. microphylla* and *G. parviflora* from *G. curvispina*, the species are relegated to the synonymy of *G. curvispina*.

Additional specimens examined. CUBA. s. loc., "Cuba oriental," 1890, *Morales 375, 475, 495* (HAC). **Camagüey:** Cubitas, Feb. 1929, *Acuña 5172, 5173* (HAC); sabanas del camino de Cubitas, Limones, Aug. 1950, *Acuña & Rodríguez 16299* (HAC); Sola, Feb. 1981, *Alvarez de Zayas et al. 43778* (HAJB); Cayo Guajaba, cerca de la loma de los Hornos, Feb. 1981, *Alvarez de Zayas, A. et al. 43791* (HAJB); Maniguas al N de Montes Grandes, May 1976, *Areces et al. 31478* (HAJB); Cayo Sabinal, camino del embarcadero de Carraguao a los montes de El Siete, Jan. 1976, *Areces 31753* (HAJB); Derramadero del Cagüey, Minas, Mar. 1987, *Avila 3045* (HACC); Camagüey to Santayana, Apr. 1909, *Britton 2368* (NY, US); savannas near Camagüey, arroyos, Apr. 1912, *Britton et al. 13113* (MO, NY, US); Cayo Sabinal on the path from Corte Jicote to "El Fuerte," Oct. 1922, *Ekman 15524* (S); Santayana in palm barrens on serpentine, June 1924, *Ekman 19049* (S); 26 km N of Camagüey on rd. to Sierra de

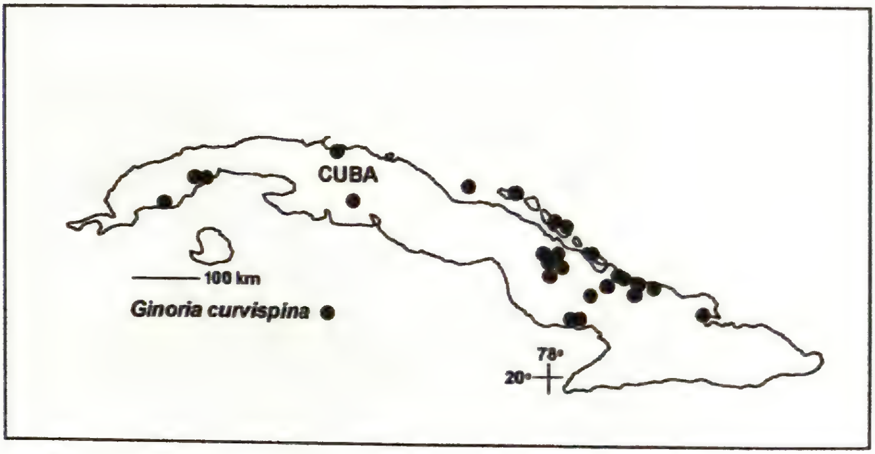

Figure 22. Distribution of *Ginoria curvispina* Koehne.

Cubitas and Paso de Lesca, 4 m W on gravel rd. to Loma Hierro, Mar. 2003, *Graham 1139* (HAC, MO); Derramadero del Cagüey, Mar. 1987, *Herrera 2996* (HACC); Sillas de Versalles, Cayo Palomo near Cayo Romano, Jan. 1936, *León 16480* (GH, HAC, HAJB, NY, US); Chromo, Apr. 1940, *León et al. 17649* (HAC, NY); Meseta de San Felipe, al NO de Ciudad Camagüey, July 1985, *Méndez 1858* (HIPC); Cayo Sabinal, costa N, Mar. 1984, *Méndez & Trujillo 3557* (HIPC); llanura serpentinícola de Lesca, entre Loma del Hierro y San Felipe, bosque de galería, Oct. 1986, *Méndez 4069* (HIPC); Montes Grandes, N de Guaímaro, Oct. 1990, *Méndez & Avila 7385, 7386* (HIPC); Ensenada Bautista, Cayo Coco, Sep. 1988, *A. Pérez 790-793* (MNHNC); Derramadero del Cagüey, Minas, Apr. 1987, *E. Pérez et al. 3809* (HACC); Cayo Romano, frente a Playa del Muerto, Feb. 1980, *Risco & Caballero 6278* (HIPC); sabana de La Matanzas, May 1915, *Roig & Luaces 825a* (HAC); camino de Cubitas, Feb. 1929, *Roig 5172* (HAC); savanna de "La Matanzas," May 1915, *Roig et al. 5999* (HAC); Cayo Romano, Oct. 1909, *Shafer 2640* (NY, US); vic. of Tiffin [Truffin], Nov. 1909, *Shafer 2878* (NY, US). **Cienfuegos:** Jagüey Chico, in swampy forest at Laguna del Juneco, Aug. 1923, *Ekman 17006* (NY, S). **Holguín:** manigua entre Playa Caletones y El Mangle, Apr. 1987, *Arias et al. 61566* (HAJB). **Las Tunas:** sabanas del Central Manatí, Nov. 1951, *Acuña 17144* (HAC); Chirimias al lado del Río Sevilla, Mar. 1981, *Barreto et al. 884* (HACC); cerca de playa Herradura, Nov. 1971, *Bisse et al. 21091* (HAJB); manigua costera, en el Socucho, playa de Puerto Padre, May 1957, *Figueiras 2918* (HAC); Mpio. Jesus Menéndez, 4 km al S de Playa Herradura, a 100 m N del camino, Mar. 2003, *Graham 1140* (HAC, MO); rd. to Playa Cobarrubias, 12 km S of Hotel Cobarrubias near the playa, Mar. 2003, *Graham 1143* (HAC, MO); Mpio. Jesus Menéndez, Las Nuevas, costa norte, Mar. 1988, *Méndez & Verdecia 4641* (HIPC); Guayabal, Amancio Rodríquez, Mar. 1990, *Verdecia & Brull 323* (IPTH); Mpio. Jesus Menéndez, Playa Genovesa, Jan. 1988, *Verdecia 50*, *Verdecia & G. Brull 3071* (IPTH); Mpio. Jesus Menéndez, El Cupey, Jan. 1991, *Verdecia & Yero 3575* (IPTH); Guayabal, Amancio Rodríguez, Mar. 1990, *Verdecia & Brull 372* (IPTH); Mpio. Jesus Menéndez, Playa Genovesa, al este de La Herradura, Nov. 1989, *Verdecia & Brull 2781* (IPTH); Mpio. Jesus Menéndez, Laguna Blanca, June 1989, *Verdecia 3676* (IPTH); Mpio. Jesus Menéndez, Las Nuevas, Apr. 1992, *Verdecia et al. 5259* (IPTH); Mpio. Jesus Menéndez, camino a Pozo Blanco, Playa Herradura, Oct. 1993, *Verdecia 6850* (IPTH); Vista Hermosa, Omaja, Matibaeva sabana con palmas, Nov. 1994, *Verdecia & Bonet 7043* (IPTH). **Matanzas:** Ciénaga de Majaguillar, Martí, May 2004, *Oviedo 42322* (HAC). **Pinar del Río:** Salado in thicket, Oct. 1920, *Ekman 11549* (S); Jejenes, S of S. Bresto, May 1928, *Fors 4787* (NY); Charco del Toro, Nov. 1986, *Manitz et al. 60393* (HAJB); Los Palacios to San Juan de Zayas near water, Jan. 1912, *Shafer 11810* (A, MO, NY, US). **Villa Clara:** Caibarién, Cayo Las Brujas, Farallón de la Boma, May 1999, *Castañeda 6913* (HPVC).

6. **Ginoria ginorioides** (Griseb.) Britton, Bull. Torrey Bot. Club 39: 13. 1912. Basionym: *Diplusodon ginorioides* Griseb., Cat. Pl. Cub. 106. 1866. *Ginoria diplusodon* (Griseb.) Koehne, Bot. Jahrb. Syst. 3: 350. 1882, nom. illeg. TYPE: Cuba. "Cuba occ.," [Pinar del Río], *C. Wright 2546* (= *1125*) (holotype, GOET!; isotypes, A!, GH!, HAC!, MO!, NY [2]!, S!, US!). Figure 23.

Shrubs or small trees to 7 m; stems glabrous; nodes unarmed, the outer edge of the nodal buttresses sometimes forming small knobs. *Leaves* with petioles 1–3(–7) mm; blades broadly elliptic to oblong, 30–90 (–110) × 20–50(–65) mm, membranous to chartaceous, green adaxially and abaxially, base acute to attenuate, apex acute to obtuse, margin membranous, often undulate, intramarginal vein present, 2–5 mm inside the margin at widest leaf diameter, secondary veins in 10 to 20 pairs, shallowly ascending to ascending, tertiary veins visible, whitish, reticulate. *Inflorescences* (1 to)5- to 12-flowered highly reduced brachyblasts to ca. 6 mm long, loosely umbelliform, some flowers also solitary in the axils of the main stem leaves; pedicels (7–)5–35(–43) mm, slender; bracteoles 0.5–2 mm, scarcely developed. *Flowers* 6-merous, subglobose in bud, campanulate at anthesis, thinly coriaceous, 9–

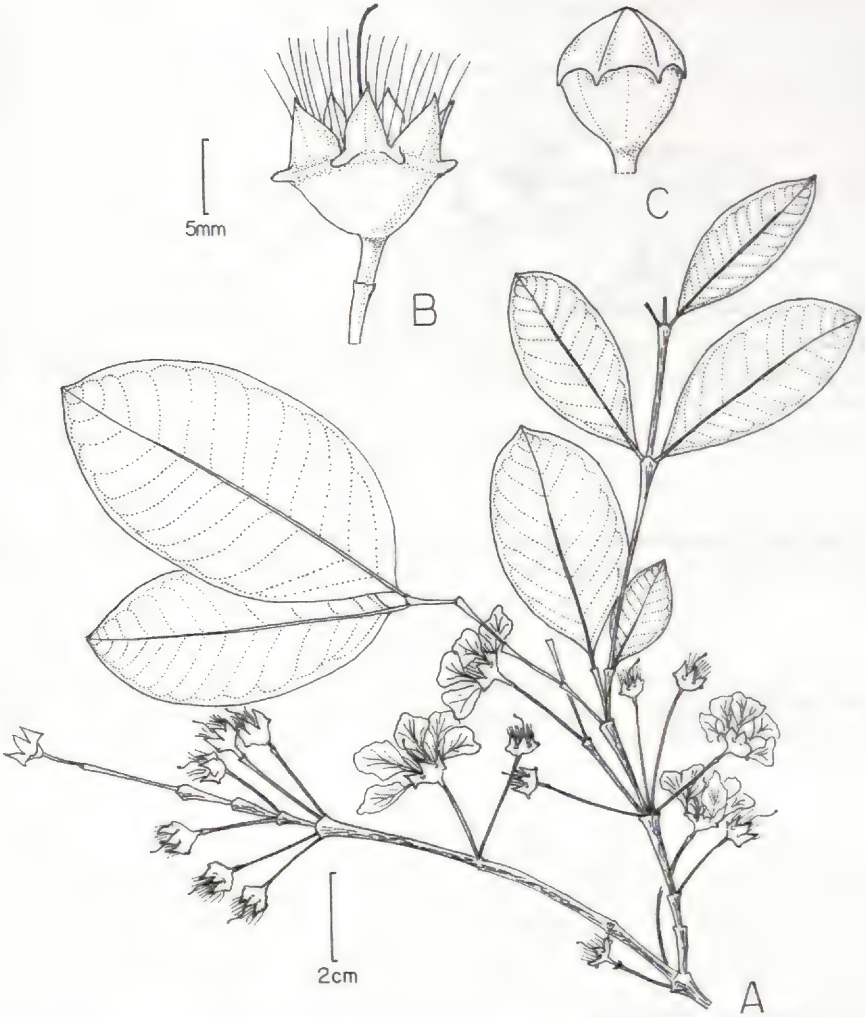

Figure 23. *Ginoria ginorioides* (Griseb.) Britton. —A. Habit (*Ekman 13742*, S). —B. Flower (*Ekman 13742*, S). —C. Floral bud (*Bisse 13173*, JE).

12 mm, 6.5–7 mm diam. at the floral cup margin, contracted to a slender epipodium 2–3 mm; floral cup 3–4.5 mm, green to wine-red within; sepals 4–4.5 × 2.5–3.5 mm, narrowly deltate, erect; epicalyx discontinuous as thickened elongate to corniform, straight or curved growths, 0.7–1.3 mm; petals 6 (indeterminately multiplied in some cultivated plants), ovate to obovate, (7–)11–14(–20) × (4–)8.5–11 mm including a claw 1–1.5 mm, light rose-purple; stamens 18 to 24 (to ca. 55), inserted ca. 1–1.5 mm below the sinuses along the distal margin of the inner tissue layer, the antesepalous stamens reaching or slightly exceeding the sepals, the antepetalous stamens included, filaments 3–4 mm, anthers 1.5–2 mm; ovary 3- to 4-locular, turning wine-red with age, style ca. 7 mm, exserted. *Capsule* globose, included, reaching the apex of the sepals; seeds ca. 1.5 × 0.3 mm, compressed, obovate to oblong-elliptic.

Distribution. *Ginoria ginorioides* is endemic to Cuba, occurring in the provinces of Pinar del Río, La Habana, Ciudad de la Habana (cultivated), Matanzas, Villa Clara, Camagüey, Cienfuegos, Sancti Spíritus, Holguín, Santiago de Cuba, Guantánamo, and on Isla de la Juventud (Fig. 24). Habitats are dry rocky bluffs, low xeromorphic woods, and semi-deciduous or evergreen forested hillsides. The plants are facultative for serpentine soils at elevations of 0 to ca. 1000 m.

Phenology. *Ginoria ginorioides* flowers and fruits from February to June, with the peak period primarily

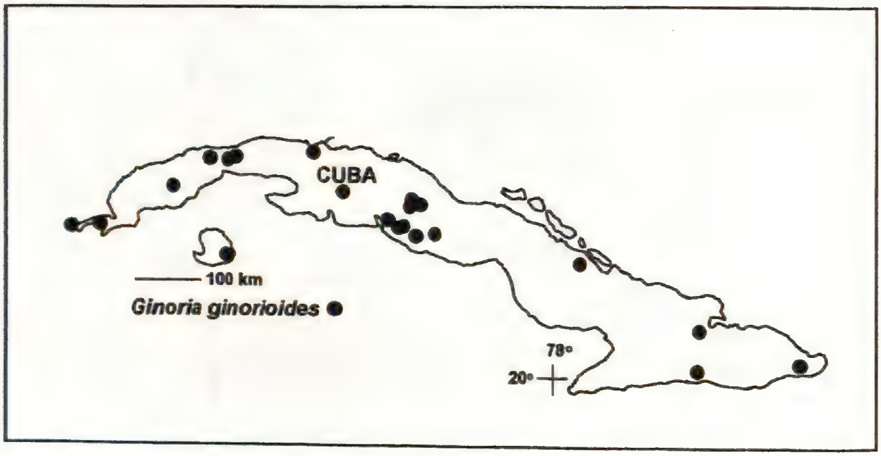

Figure 24. Distribution of *Ginoria ginorioides* (Griseb.) Britton.

in March and April. Flowers typically appear prior to full development of the new season's leaves.

Common names. Cuaresmilla árbol, júpiter árbol (León & Alain, 1953; Roig y Mesa, 1963).

Discussion. *Ginoria ginorioides* is a species of beautiful, floriferous, spineless shrubs or trees distinguished by large leaves with undulate margins, prominent reticulate veins, and wide intramarginal tissue. The leaves are the largest produced by the genus in Cuba and are exceeded only by the largest leaves of *G. buchii* in Hispaniola. The elongate to corniform epicalyx segments, prominently visible on the buds, are diagnostic. In flower, the light rose-purple flowers form loose, showy, umbel-like clusters. A specimen in the Cienfuegos Botanical Garden transplanted from an unknown site in the wild is particularly attractive as a horticultural shrub because the flowers have multiplicative petals, and up to 55 stamens. Britton records *G. ginorioides* as a tree to 7 m tall at sea level in Cienfuegos and as a shrub on the southern slope of the Trinidad Mountains (Britton, 1912). Flowering typically precedes leaf production.

The type of *Ginoria ginorioides* was collected in March 1863 at Finca Retiro near Taco Taco, Pinar del Río, where Wright stayed from June 1862 to August 1864 (Howard, 1988; field notes of *Wright 2546*, GH).

Additional specimens examined. CUBA. **Camagüey:** Río Máximo, Sierra de Cubitas, May 1915, *Roig et al. 6092* (HAC, HAJB). **Cienfuegos:** Sierra del Escambray, Matagua de la Vega, Mar. 1969, *Bisse 13173* (JE); Sierra del Escambray, cafetal de Buenos Aires, Mar. 1969, *Bisse & Lippold 13175* (HAJB); Sierra del Escambray, orillas de un arroyo cerca de Buenos Aires, Aug. 1972, *Bisse 23253* (HAJB); Sierra del Escambray, loma al S del Pico San Juan, Mar. 1976, *Bisse et al. 30919* (HAJB); Trinidad Mtns., San Blas-Buenos Aires, Mar. 1942, *Gonzales 655* (A, NY, S); Jardín Botánico de Cienfuegos, garden plant #3854, original source unknown, Mar. 2003, *Graham 1144* (HAC, MO); Buenos Aires, rocky cliffs, *Hunnewell 11577* (GH); Las Vegas de Matagua above San Blas, La Sierra, Apr. 1928, *Jack 5967* (A, HAC, S, US); Soledad, trail on rd. to Buenos Aires, Apr. 1928, *Jack 5969* (AJBC); Las Lagunas, Buenos Aires, Mar. 1929, *Jack 7028* (A); Las Lagunas, Buenos Aires, Apr. 1930, *Jack 7899* (US); Las Lagunas, Buenos Aires, Trinidad hills, Apr. 1930, *Jack 7970* (AJBC); hills near San Blas, Feb. 1928, *Rehder 1165* (A); Mina Carlota, SE of Cumanayagua, Mar. 1938, *Senn 179* (GH). **Ciudad de la Habana:** cultivated, Jardín Botánico de la Universidad de la Habana, Feb. 1925, *Acuña 14301* (HAC), Mar. 1906, *van Hermann 2677* (HAC). **Guantánamo:** Baracoa, entre boca de Jauco y Monte Cristo, May 1968, *Bisse & Köhler 8053* (HAJB, JE). **Holguín:** Julio A. Mella, Pinares de Mayarí, alto de la Estrella, May 1983, *Bisse et al. s.n.* (HAJB). **Isla de la Juventud:** camino de Cayo Piedras a Punta del Este, Apr. 1980, *Alvarez de Zayas et al. 41947* (HAJB); camino hacia Punta del Este desde Cayo Piedras, Apr. 1974, *Berazaín & Areces 24889* (HAJB); parte S de Isla de Pinos, en el camino de Cayo Piedra a Punta del Este, May 1975, *Lippold et al. 26187* (HAC, HAJB). **La Habana:** Laguna de Ariguanabo at the edge of Río Ariguanabo in low forest, Apr. 1922, *Ekman 13742* (NY, S, US); San Antonio de Los Baños, May 1915, *León & Alcine 5029* (GH, HAC, HAJB, NY, US), *5200* (HAC). **Matanzas:** coral-rock cliffs, valley of the Canimar, Mar. 1903, *Britton et al. 446* (HAC, NY). **Pinar del Río:** Consolación del Sur, pineland hills at Juan Moreno, Apr. 1920, *Ekman 10871* (NY, S, US); Sierra de los Organos, grupo del Rosario, in the desfiladero de Río Santa Cruz on steep limestone rocks, Mar. 1923, *Ekman 16405* (S); Cabo San Antonio, *Expedición 1ra Bot. Nacional Jardín 5136* (HIPR); Guanahacabibes entre El Veral y el primer farallón, Mar. 1989, *Méndez & Verdecia 992* (IPTH); Guanahacabibes, Faro Roncalli, Mar. 1989, *Méndez & Verdecia 1013* (IPTH); Las Tumbas, cabo de San Antonio, Mar. 1989, *Méndez & Verdecia 4718* (HIPC); carretera que va al primer farallón, Guanahacabibes, Mar. 1989, *Méndez & Verdecia 4843* (HIPC); cerca del Faro, Cabo San Antonio, Apr. 1924, *Roig 3249* (HAC, NY); cerca del faro, Cabo de San Antonio, Apr. 1924, *Roig 8548* (HAC). **Sancti Spíritus:** en la cresta del Pico Potrerillo, Apr. 1959, *Alain 6700* (HAC, HAJB); falda S de las Lomas de Banao, Nov. 1975, *Alvarez de Zayas et al. 28787* (HAJB); faldas S de las lomas de Banao, *Areces et al. 45158* (HAC), *HAJB 28787* (HAC); La Sabina Potrero del Consejo Area Protegida El Naranjal, Lomas de Banao, Mar. 1993, *Béquer 303* (HJSS); mogote, camino a El Naranjal, Area Protegida El Naranjal, Banao, Aug. 1994, *Béquer et al. 6661* (HACC); Trinidad Mtns., Arroyo Grande to Trinidad on ridge, Mar. 1910, *Britton & Wilson 5474* (NY, US); Trinidad, Río Tayaba, rocky bank, Mar. 1910, *Britton et al. 5560* (NY, US), *5577* (NY, US); Río San Juan on cliff, Mar. 1910, *Britton et al. 5858* (NY), *5900* (NY, US), *5903* (NY, US); Topes de Collantes, Mogote Mi Retiro, base de la loma, May 1999, *Castañeda & Vera 6837* (HPVC); in the foothills on the rd. from Trinidad to San Juan de Letrán, Mar. 1924, *Ekman 18919* (S); mtns. of the Siguanea-Trinidad group, Pico Potrerillo, on the top of this mtn., Mar. 1924, *Ekman 18966* (S); Pico Potrerillo, Apr. 1987, *Noa et al. 1453* (HPVC); Loma Mi Retiro, al O de Pico Potrerillo, May 1990, *Noa et al. 3843* (HPVC); Topes de Collantes, Mar. 1971, *Stuchlik 27224* (HAC); Río San Juan, Escambray, May 1986, *Martínez & Trujillo 9020* (HIPC). **Santiago de Cuba:** Florida Blanca, Mar. 1931, *Bucher 5223* (HAC). **Villa Clara:** Cuabales del Escambray, S de Santa Clara, Apr. 1954, *Alain 3965* (GH, HAC); Santa Clara camino de Pelo Malo, Apr. 1979, *Alfonso et al. 153* (HPVC); Santa Clara city, palm barren, Mar. 1910, *Britton et al. 6083* (NY); Mar. 1911, *Britton & Cowell 10188* (NY); Santa Clara city at a brook, Apr. 1922, *Ekman 14052* (NY, S); Santa Clara city, in charrascales along brooks, Mar. 1924, *Ekman 18824* (NY, S, US); Santa Clara, La Cumbre, Mar. 1924, *Ekman 18973* (S); Santa Clara, El Playazo, Area Protegida Cubanacán, a 1 km del restaurante "La Parrillada" en el Centro Recreativo Arco Iris, Mar. 2003, *Graham 1136* (HAC, MO); 10 km S of Santa Clara in wet ravines in serpentine area, July 1950, *Howard et al. 122* (A, AJBC); banks of Río Primero, near Santa Clara, Mar. 1934, *León 16076* (GH, HAC, NY, US); Santa Clara, Corojito, Feb. 1997, *Matos et al. FF 590* (HPVC); Olla, panteaguas desde casa a Copey, Feb. 2000, *Matos FF 1725* (HPVC); La Hoya, May 1983, *Noa et al. 427* (HPVC); La Hoya, Santa Clara, May 1984, *Noa et al. 560* (HPVC); alrededores de la presa "Gramal," June 1985, *Noa 623* (HPVC); camino de Las Clavellinas, camino hacia Palma Sola, July 1990, *Noa & Castañeda 3933* (HPVC); Las Clavellinas, próximo al camino de La Movida, orillas del Río Primero, Mar. 1991, *Noa 4095* (HPVC); Loma Cuchilla, Laguna Agabama, June 1987, *A. Pérez 244* (MNHNC).

7. **Ginoria glabra** Griseb., Cat. Pl. Cub. 106. 1866. TYPE: Cuba. "Cuba or.," *C. Wright 2544* (= *91*) (lectotype, designated by Echevarría & Graham, 2008, GOET!; isotypes, A!, GH [2]!, GOET!, HAC!, MO!, NY!). Figure 25.

Ginoria montana Britton & P. Wilson, Bull. Torrey Bot. Club 50: 43. 1923. TYPE: Cuba. Granma/Santiago de Cuba: "Sierra Maestra, Oriente," farallón Regino, Alta Maestra, 24 July 1922, *León 11009* [co-collected with *E. K. Ekman 14614*] (holotype, NY!; isotypes, GH!, HAC!).

Small shrubs 1–2 m; stems with ascending branches, glabrous; nodes unarmed. *Leaves* with petioles 2–6 mm; blades ovate-oblong or ovate-lanceolate, 20–90 × 7–35 mm, coriaceous, glabrous, dark green and shining adaxially, paler abaxially, base acute to rounded, apex acuminate-obtuse or merely obtuse, margin thickly membranous, intramarginal vein present, 0.5–3 mm inside the margin at widest leaf diameter or sometimes partially merging with the margin on smaller leaves, secondary veins in 5 to 10 pairs, subhorizontal to ascending, tertiary veins obscure, thick, yellowish, densely reticulate. *Inflorescences* 1- to 3(to 6)-flowered brachyblasts, 3–25 mm, subumbelliform, some flowers also solitary in the axils of the main stem leaves; pedicels (9–)16–24 mm, slender, erect or lax; bracteoles ca. 2.5 mm, broadly ovate to spatulate. *Flowers* 6-merous, globose to obovoid in bud, campanulate at anthesis, membranous, 6–9 mm, 5–7 mm diam. at the floral cup margin, contracted to a stout epipodium 0.5–1.5 mm or epipodium absent; floral cup 3–3.5 mm, green; sepals 2.5–4 × 1.5–2 mm, narrowly deltate, spreading to mostly strongly deflexed at anthesis; epicalyx a narrow continuous flange 0.3–0.4 mm wide, encircling the exterior of the floral cup at the base of the sepals, slightly broadening at each sinus to form a small lobe ca. 0.5 mm wide; petals 6, obovate, 11–20 × 8.5–11 mm including claw 1–1.5 mm, rose-purple; stamens 28, inserted 1–1.5 mm below the sinuses of the sepals, on the distal edge of the narrowly free margin of the inner tissue layer, exserted, filaments 3–4 mm, anthers ca. 1.7 mm; ovary 4- to 5-locular, slightly depressed, shallowly 6-sulcate, green; style ca. 7 mm, exserted. *Capsule* globose, exserted ca. 2 mm; seeds 0.8–1 × ca. 0.2 mm, compressed, obovate to oblong-elliptic.

Distribution. *Ginoria glabra* is endemic to southeastern Cuba, occurring in the provinces of Granma, Santiago de Cuba, and Guantánamo (Fig. 26). It grows in gallery forests, montane rainforests, and on rocky slopes in coastal matorrral between 10 and 1500 m.

Phenology. The species has been collected in flower and fruit in July and August. Flowering possibly begins in May or June, and fruits persist into the next flowering season.

Common names. Clavellina de paredón, cuaresmilla de paredón (León & Alain, 1953; Roig y Mesa, 1963).

Discussion. Diagnostic features of *Ginoria glabra* include: spineless nodes, petiolate ovate-oblong or lanceolate leaves with an obtuse apex that is often briefly acuminate, and 6-merous flowers with a prominent narrow flange encircling the floral cup. The flowers, with large rose petals, appear simultaneously with the leaves. Specimens with the type number were collected at Potosí in October and "in the pebbly bed of the [Yateras] River, July 2," localities ca. 20–30 km north and northwest of Guantánamo. According to Howard, who cited correspondence from Gray to Grisebach (Howard,

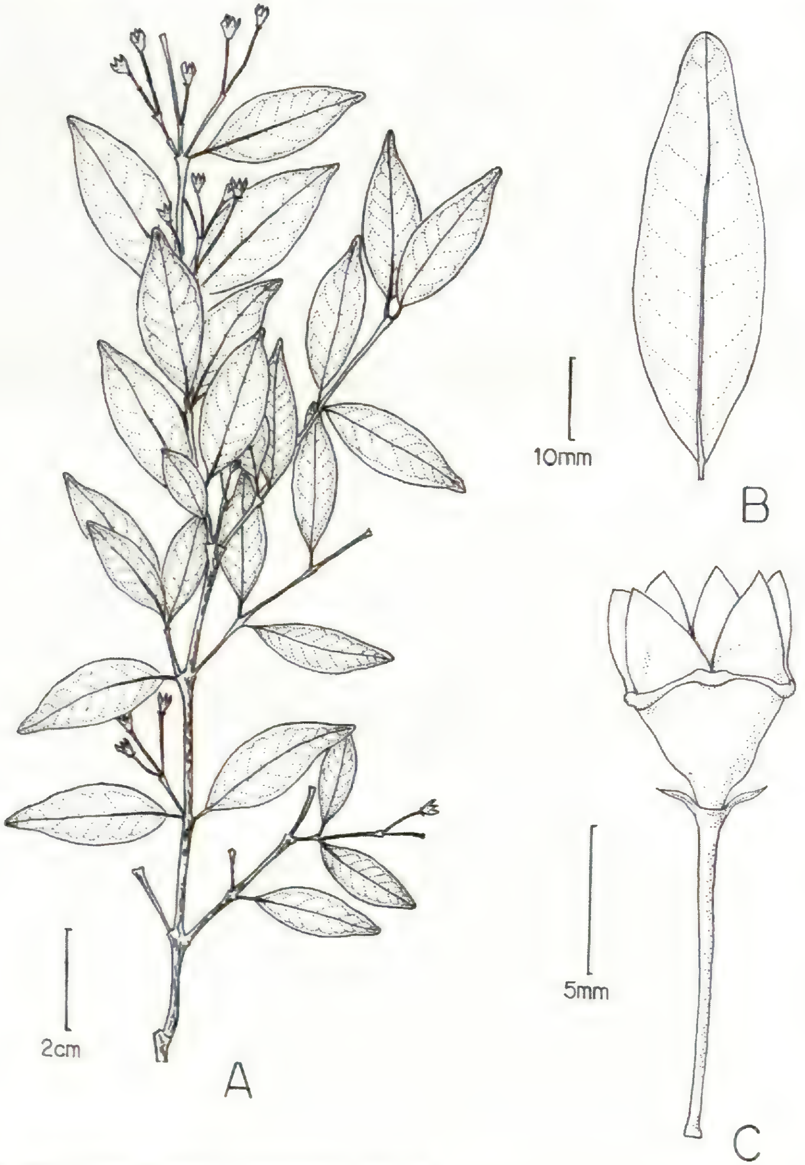

Figure 25. *Ginoria glabra* Griseb. —A. Habit (*Ekman 14614*, S). —B. Leaf, abaxial view (*Ekman 14614*, S). —C. Flower (*Ekman 14614*, S).

1988: appendix 3), the Yateras District was "in the elevated district back of Santa Catalina de Guantánamo where the collector's [Charles Wright's] principal station was Monte Verde, a coffee plantation and residence of the most estimable and hospitable M. Lescaille." The species has been collected twice on farallón La Perla, at Monteverde, Guantánamo, which is probably in the type area.

The type of *Ginoria montana*, *León 11009*, was collected on the steep rocky slopes of Loma Regino to the west of Pico Turquino and ca. 200 km west of the type area of *G. glabra* in Guantánamo Province. *Ginoria montana* differs from *G. glabra* only in having leaves with slightly denser, yellowish tertiary veins and a more acute leaf base. Flowers on the type of *G. montana* are immature but display the same undulate encircling epicalyx as *G. glabra*. Mature flowers and leaves on *Seifriz 1046* from the southern slopes of Pico Turquino in the general type area of *G. montana* compare favorably with those of *G. glabra*. The

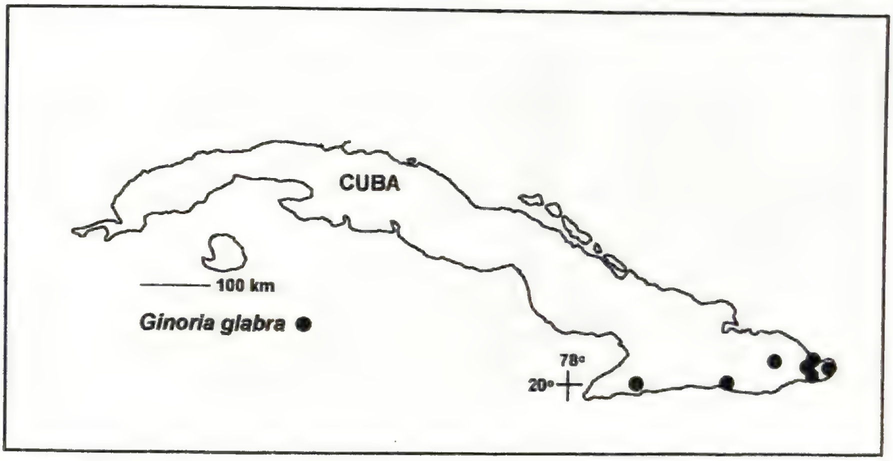

Figure 26. Distribution of *Ginoria glabra* Griseb.

differences between *G. glabra* and *G. montana*, as far as they are presently known, do not justify recognition of two species. Seeds distributed as *G. glabra*, Fairchild Tropical Garden FG-1753C, originating from the Botanical Garden, University of Havana, Cuba, were used for chromosome counts (Tobe et al., 1986) and molecular analyses (Graham et al., 2005). This collection is now correctly identified as *G. americana* Jacq.

Additional specimens examined. CUBA. **Granma/Santiago de Cuba:** Sierra Maestra in steep rocks of Loma Regino, July 1922, *Ekman 14614* (NY, S). **Guantánamo:** Baracoa, entre boca de Jauco y Monte Cristi, *Bisse s.n.* (HAC); Monte Verde, farallón La Perla, Dec. 1960, *Figueiras 2444* (HAC, HAJB); southern Baracoa region, banks of Jauco River, July–Aug. 1924, *León 11768* (GH, HAC, HAJB, NY, US); Altos del Yumurí, entre Maisí y Baracoa, Aug. 1939, *León 17229* (GH, HAC, NY, US); banks of Río Mayo, Maise [Maisí], Oct. 1938, *León 18571* (GH, HAC, NY, US); Río Mayo, Maisí, Oct. 1938, *Matos 18571* (HAC); farallón La Perla, Feb. 1911, *Shafer 8784* (A, NY, US). **Santiago de Cuba:** línea antigua de Firmeza, Aguadores, Santiago, Nov. 1945, *Clemente 4872* (HAC); Sierra Maestra, July 1922, *León 11069* (HAC); Pico Turquino, S slopes, July 1940, *Seifriz 1046* (US).

8. **Ginoria jimenezii** Alain, Brittonia 20: 157. 1968. TYPE: Dominican Republic. "In woods, very rare, Jaiquí Picao [Jaiquí Picado], Santiago Prov., Jul. 1954," *F. Jiménez 2684* (holotype, US!; isotype, US!). Figure 27.

Small trees 4–15 m; stems glabrous; nodes unarmed. *Leaves* with petioles 1–2 mm; blades narrowly elliptic-lanceolate or oblong, 20–68 × 8–29 mm, thickly membranous, glabrous, opaquely green and somewhat glaucous adaxially, paler and yellowish green abaxially, base acute, apex obtuse, often with a mucronate tip, margin membranous, intramarginal vein usually present, 1–2 mm inside the margin at widest leaf diameter, secondary veins in ca. 10 pairs, ascending, obscure, tertiary veins obscure, finely reticulate. *Inflorescences* racemose, flowers solitary or paired in the axils of the leaves; pedicels 15–35 mm, slender, lax; bracteoles 1–1.5 mm, subulate. *Flowers* 4-merous, subglobose in bud, campanulate at anthesis, thickly coriaceous, 8–9 mm, ca. 7 mm diam. at the floral cup margin, contracted to an epipodium 1–3 mm; floral cup 3–4 mm, green; sepals 3–4 × 2.5–4 mm, deltate, spreading at anthesis; epicalyx absent, the sinuses of the sepals sometimes slightly thickened; petals 4, oblong-obovate, 12–17 × 8–11 mm, violet; stamens 16 to 24 (possibly more), inserted ca. 2–3 mm below the sinuses at the distal margin of the inner tissue layer, filaments 6–7 mm, anthers ca. 1.6 mm; ovary 4-locular, green; style 6–10 mm, exserted. *Capsule* globose, probably included; seeds unknown.

Distribution. *Ginoria jimenezii* is endemic to the Dominican Republic, occurring in the northern provinces of Santiago and Espaillat in woodlands and along the margin of an arroyo with *Mora* Benth., *Manilkara* Adans., *Tabebuia* Gomes ex DC., *Vitex* L., and *Eugenia* L. at elevations of 60–520 m (Fig. 19).

Phenology. The flowering and fruiting period of this species is uncertain; possibly it is mainly April–July. Fruiting specimens have been collected in June and July, and one flowering collection was made in September.

Discussion. This rare species is recognized by the combination of unarmed nodes, elliptic-lanceolate or

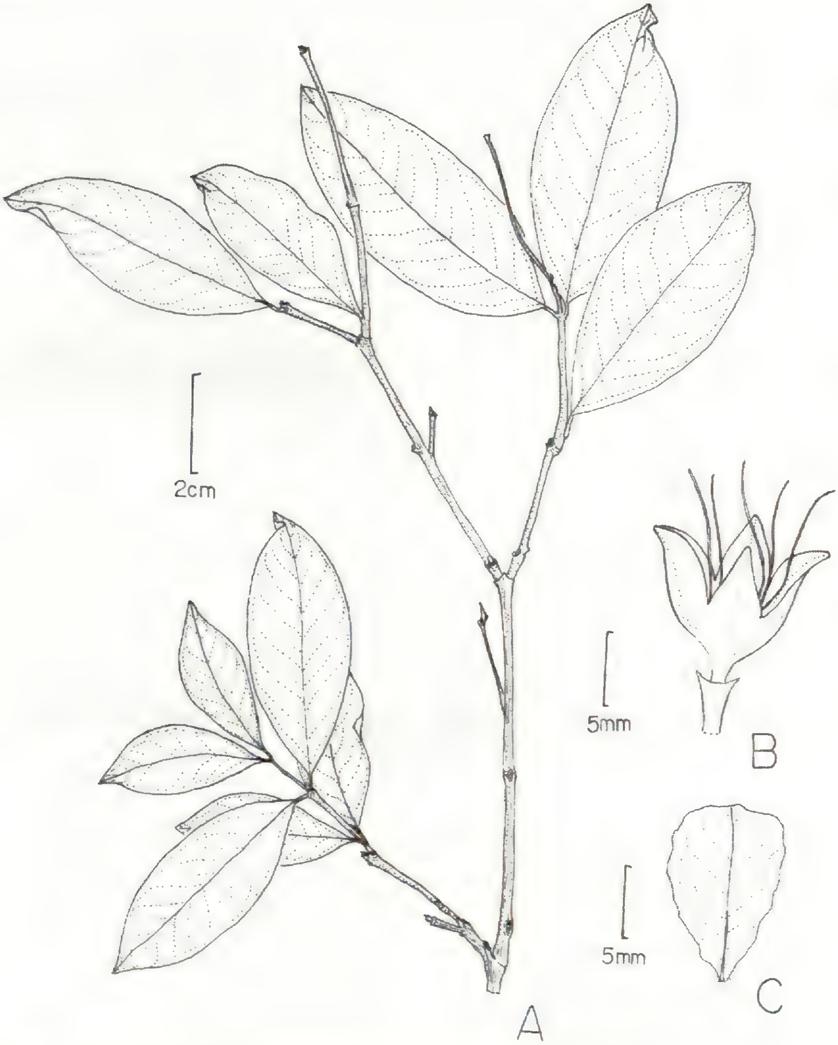

Figure 27. *Ginoria jimenezii* Alain. —A. Habit (*García & Jiménez 3614*, MO). —B. Flower. —C. Petal (B, C from *Canela L. s.n.*, NY).

oblong leaves to 68 mm long, and solitary 4-merous, thickly coriaceous flowers that lack an epicalyx. It is known at the present time from a single apparently sterile tree at the site near Gaspar Hernández. Botanists from the National Botanic Garden in Santo Domingo who have made several visits to re-collect the species have not found the tree in flower.

Additional specimens examined. DOMINICAN REPUBLIC. **Espaillat:** 8.5 km al E de Gaspar Hernández, Jan. 1992, *García & Jiménez 3614* (JBSD, MO); 8.5 km al E de Gaspar Hernández, 800 m al S de la carretera, en la margen del arroyo El Guano, Mar. 2001, *García & Pimentel 7411* (JBSD). **Santiago:** Manacla, en vera arroyo, Sep. 1938, *Canela L. s.n.* (NY, US).

9. Ginoria koehneana Urb., Feddes Repert. Spec. Nov. Regni Veg. 18: 20. 1922. TYPE: Cuba. Guantánamo, "in parte centrali-septentr. prope San Germán in sylvis rarissima, m. Aug. fruct.," 5 Aug. 1915, *E. L. Ekman 6356* (lectotype, designated by Graham, 2005: 301, NY!; isotypes, S!, US!). Figure 28.

Ginoria thomasiana Alain, Revista Soc. Cub. Bot. 10: 30. 1953. TYPE: Cuba. Pinar del Río: "Cuabales de Cajálbana, Junio 10, 1950," *J. B. Acuña & Bro. Alain 16182* (holotype, HAC! [transferred from SV]).

Small trees to 3 m; stems much branched, the branches short with abbreviated internodes 3–20 mm

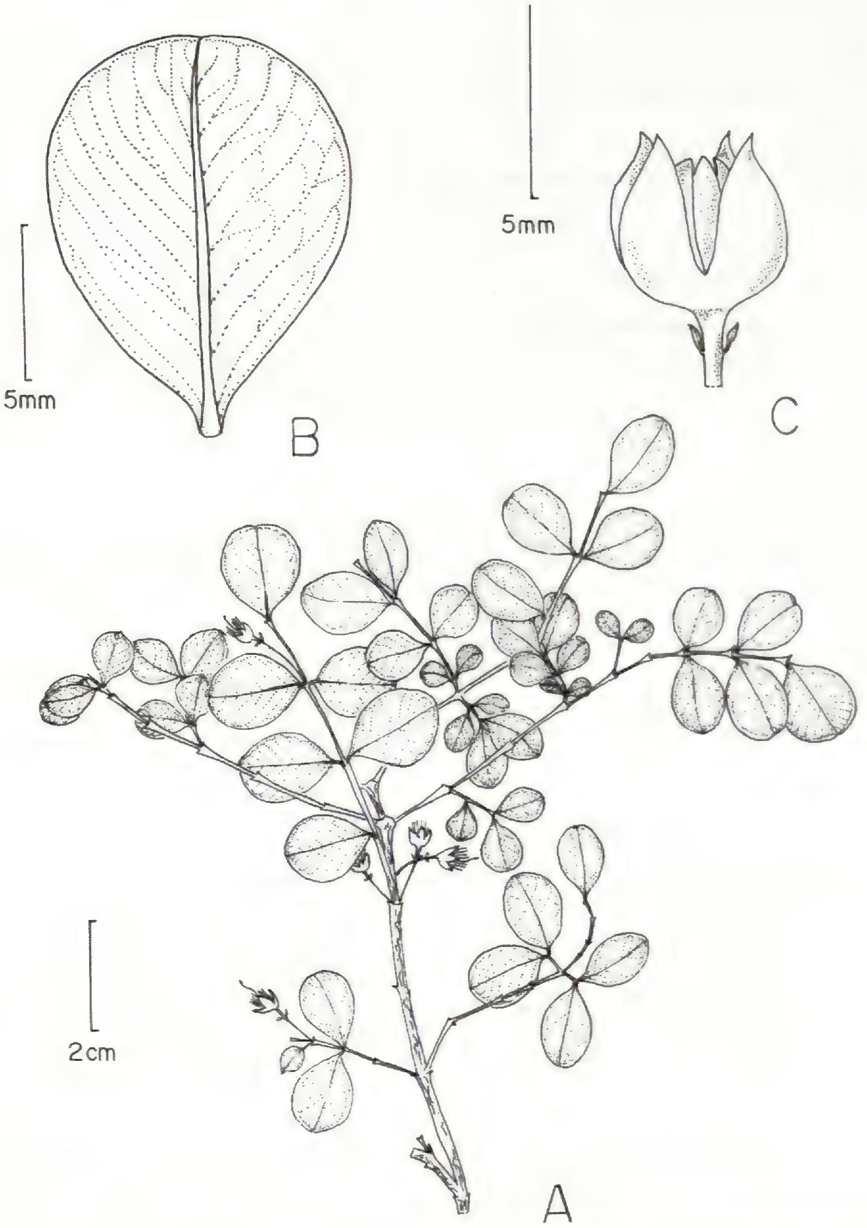

Figure 28. *Ginoria koehneana* Urb. —A. Habit. —B. Leaf, abaxial view. —C. Flower in fruit with dehisced capsule. A–C from *Ekman 6356* (S).

long, glabrous; nodes armed by 4 strong, horn-like spines of 1–2 mm, the spines recurved, spreading, or slightly erect, or (in Pinar del Río) spines sometimes much reduced or absent. *Leaves* sessile, crowded toward the tips of the stem; blades obovate to suborbicular, less often oblong-elliptic or elliptic, 10–25 × 5–20 mm, coriaceous, dark green and shining adaxially, opaque abaxially, base sharply acute, apex obtuse and often apiculate, margin white-cartilaginous, intramarginal vein present, 0.2–1 mm inside the margin at widest leaf diameter, secondary veins in 8 to 10 pairs, acutely ascending, tertiary veins thick, obscure. *Inflorescences* 1- to 9-flowered brachyblasts, loosely subumbelliform, some flowers

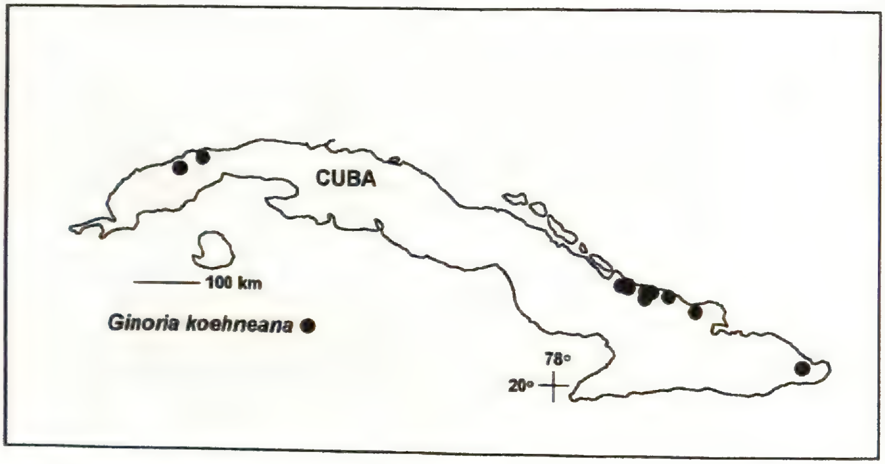

Figure 29. Distribution of *Ginoria koehneana* Urb.

also solitary in the axils of the main stem leaves; pedicels 6–17 mm, thin, lax; bracteoles 0.3–1 mm, lanceolate-linear. *Flowers* 4-merous, globose in bud, shallowly campanulate at anthesis, thickly membranous to coriaceous, 3–4.5 mm, ca. 4 mm diam. at the floral cup margin, abruptly contracted to a slender epipodium ca. 1 mm long; floral cup 0.7–1, green; sepals 2–3.5 × 1.5–2 mm, narrowly deltate with short acuminate tip, erect to slightly spreading at anthesis; epicalyx absent; petals 4, ovate-triangular or oblong, 2.5–3.5 × ca. 2 mm including a claw ca. 0.5 mm, scarcely exceeding the sepals, white; stamens (12 to)14 to 16, inserted ca. 0.5 mm below the sinuses along the distal margin of the inner tissue layer, included to scarcely exceeding the sepals, filaments 0.5–0.8 mm, anthers ca. 0.5 mm; ovary 2- to 3-locular, green; style ca. 3 mm (fide Urban), included or short-exserted. *Capsule* globose, included; seeds 0.5–0.7 × ca. 0.1 mm, compressed, obovate or oblong-elliptic.

Distribution. *Ginoria koehneana* is endemic to Cuba, appearing disjunctly in northwestern and northeastern Cuba, in the provinces of Pinar del Río, Las Tunas, Holguín, and in central Guantánamo (Fig. 29). It grows on rocky serpentine and limestone soils in semi-deciduous woods and in xeromorphic matorral inland of mangroves near the coasts at 0–100 m.

Phenology. *Ginoria koehneana* has been collected in flower from June through August, and fruits are present on specimens collected in August.

Common names. Yema de huevo, guairaje espinoso (León & Alain, 1953; Roig y Mesa, 1963).

Discussion. *Ginoria koehneana* is a large, much-branched, spiny shrub or small tree with thickly coriaceous leaves crowded on short secondary branches. It is typically armed by strong, short spines, although spineless specimens have been noted in northwestern Pinar del Río. Flowers are 4-merous, small for the genus, and mostly fall away with their slender epipodium soon after flowering. Few collections have been made and where the species grows, collectors have noted its rarity. We found a single sterile tree with new leaves in a dense inland thicket on serpentine rocks adjacent to mangroves at Puerto Padre, Las Tunas, in the month of March, but on two occasions were unable to relocate the species at former collection sites in northwestern Pinar del Río. The close floral similarity and probable sister relationship to *G. arborea* are noted under that species.

The holotype of the western Cuban *Ginoria thomasiana* has ascending, slightly incurved spines and elliptic leaves, whereas another western collection, *Ekman 17406* (NY), has no spines and obovate leaves. *Ginoria koehneana* from eastern Cuba has descending, slightly recurved spines and mostly obovate leaves. Variation in spine development and leaf shape has been documented in a far more commonly occurring species, *G. americana*, so that such variation in *G. koehneana* is not unique to the genus. Given that *G. koehneana* and *G. thomasiana* have identical flowers and allowing for variation of spine position and leaf shape, the two species are considered conspecific, a conclusion the author of *G. thomasiana* subsequently reached (Liogier, 1969: 114).

Additional specimens examined. CUBA. **Guantánamo:** San Germán in forest, laterite on limestone, Aug. 1916, *Ekman 7428* (NY, S, US). **Holguín:** Loma del Templo, al Ode la bahía del Naranjo, Oct. 1978, *Bisse et al. 38193* (HAJB). **Las Tunas:** Jesús Menéndez, Las Resbalosa, La Saya, Oct. 1991, *Brull & Verdecia 5432* (IPTH); La Saya, Puerto Padre, Feb. 1930, *Curbelo 206* (HAC); coast at La

Resbalosa, Puerto Padre, Aug. 1930, *Curbelo s.n.* (NY); La Resbalosa, La Saya, Puerto Padre, July 1932, *Curbelo 229* (HAC, NY); proximidades de Puerto Padre, June 1932, *Curbelo 24166* (HAC, HAJB); Playa Cobarrubias, ca. 100 m from Hotel Cobarrubias at the intersection of the main rd. to the playa and the rd. to Antiguo Rancho, Mar. 2003, *Graham 1142* (FTG, HAC, MO); La Isleta Manatí, matorral xeromorfo costero, May 1995, *Verdecia 6938, 7660* (IPTH). **Pinar del Río:** La Cajálbana, Dec. 1949, *Acuña & Alain 8997* (HAC); cuabales de Cajálbana, Dec. 1949, *Acuña & Alain 15819* (HAC); cuabales serpentinosos, Loma de la Cajálbana, La Palma, Dec. 1949, *Alain & Acuña 1203* (GH, HAC); El Morrillo, Toscano, Cayo Alfiler, al final del cuartón de Las Carabelas, Mar. 1987, *Colaboradores del Flora de Cuba 62522* (HAJB); Finca Toscano, Bahía Honda, Mar. 1987, *Méndez 3302* (HIPC); Finca Toscano, Bahía Honda, Aug. 1986, *Olviedo & Delgado 3149* (HAC, HIPCR); Toscano [finca near Playa el Morillo], in manigua bordering on manglares, a tree, very rare, Sep. 1923, *Ekman 17406* (NY, S).

10. Ginoria lanceolata O. C. Schmidt, Ark. Bot. 21A(5): 16. 1927. TYPE: Haiti. "Peninsula septenr.-occid. prope Port-de-Paix ad Saline Michel ad occid. versus, mense Aug. 1925," *E. L. Ekman 4575* (lectotype, designated by Graham, 2005: 301, NY!; isotypes, EHH not seen, GH!, S [2]!, US [2]!). Figure 30.

Small trees with deeply furrowed bark, height unknown; stems with short terminal branches and internodes, glabrous; nodes armed by (2 to)4 spines, the spines slender, spreading or slightly ascending, 2–4 mm, tips straight or slightly recurved. *Leaves* with petioles to 1 mm; blades narrowly ovate-lanceolate to lanceolate, 10–25 × 4–10(–15) mm, coriaceous, shining and gray-green adaxially, paler abaxially, base acute, apex acute to narrowly acuminate, margin formed by the intramarginal vein, cartilaginous, secondary veins in 5 to 10 pairs, sharply ascending, tertiary veins obscure. *Inflorescences* composed of a few solitary flowers in the leaf axils; pedicels 8–10 mm, slender, lax; bracteoles unknown. *Flowers* 4-merous, obovoid in bud, campanulate at anthesis, thickly membranous, 5–5.5 mm, 4–4.5 mm diam. at the floral cup margin, abruptly contracted to a slender epipodium ca. 1 mm; floral cup 1–1.5 mm, green; sepals 2.5–3 × ca. 1.5 mm, narrowly deltate with acute apex, erect at anthesis, remaining erect in fruit; epicalyx absent; petals unknown; stamens 8, inserted ca. 0.5 mm below the sinuses along the distal margin of the inner tissue layer, the 4 antesepalous stamens slightly exceeding the sepals, the 4 antepetalous ones included, filaments 3–4.5 mm, anthers unknown; ovary 3-locular, color unknown; style length unknown. *Capsule* dark brown, oblong, equal to or exserted ca. 0.5 mm beyond apex of the sepal; seeds ca. 0.8 × 0.1 mm, compressed, obovate to oblong-elliptic.

Distribution. A rare endemic of Haiti in Department Nord-Ouest (Fig. 31), *Ginoria lanceolata* is known from the type and one other collection. Both collections are from limestone terraces at ca. 50 m.

Phenology. *Ginoria lanceolata* has been collected in flower and old fruit in March; the sterile type collection was made in August.

Discussion. The collections made in 1925 and 1928 by Ekman remain the only known examples of the species. Flowers and fruits of *Ginoria lanceolata* are described here for the first time from the sparsely flowered *Ekman 9696*, the type number being sterile. The species uniquely combines slender, spreading nodal spines, lanceolate leaves 25 mm or less with sharply ascending secondary veins, and a margin formed by the intramarginal vein. The habit is distinctly xeromorphic. *Ginoria lanceolata* is most similar to *G. arborea*, a species restricted to extreme southeastern Cuba, which differs by linear-oblong, not ovate-lanceolate to lanceolate, leaves and 12 to 14 stamens versus eight in *G. lanceolata*. In the protologue, Schmidt compared leaves of *G. lanceolata* to the dissimilar leaves of *G. koehneana*, which are typically obovate with a distinct intramarginal vein. The flowers of *G. lanceolata*, however, are similar to those of *G. koehneana* and *G. arborea*; all are 4-merous and among the smallest in the genus. Ecologically, the three species also share the same specialized habitat type, growing on limestone in coastal areas.

It is remarkable that in extreme northwestern Haiti, *Ginoria* is represented by three narrowly endemic species of very different morphology, and unfortunate that all are rare or conceivably now extinct. *Ginoria pulchra* was rediscovered on a precarious cliff side at its type locality in 1985 (*Zanoni et al. 33439*), but neither *G. lanceolata* nor *G. callosa* has been re-collected since Ekman found them in the 1920s. There is hope that inacessibility to the steep limestone cliff habitats of the latter two has preserved them, as it did for *G. pulchra*, at least until 1985.

Additional specimens examined. HAITI. **Nord-Ouest:** Presque île du Nord-Ouest, Port-de-Paix, limestone terraces W of Saline-Michel, Mar. 1928, *Ekman 9696* (A, S).

11. Ginoria nudiflora (Hemsl.) Koehne, Bot. Jahrb. Syst. 3: 351. 1882. Basionym: *Antherylium nudiflorum* Hemsl., Diagn. Pl. Nov. Mexic. 1: 13. 1878. TYPE: Mexico. Oaxaca: "Sierra San Pedro Nolasco, Talea, etc.," *C. Jurgensen 956* (holotype, K!; isotypes, G!, K!). Figures 1, 32.

Ginoria davisii M. C. Johnst., Southw. Naturalist 1: 39. 1956, syn. nov. TYPE: Mexico. Veracruz: "about 40 mi north

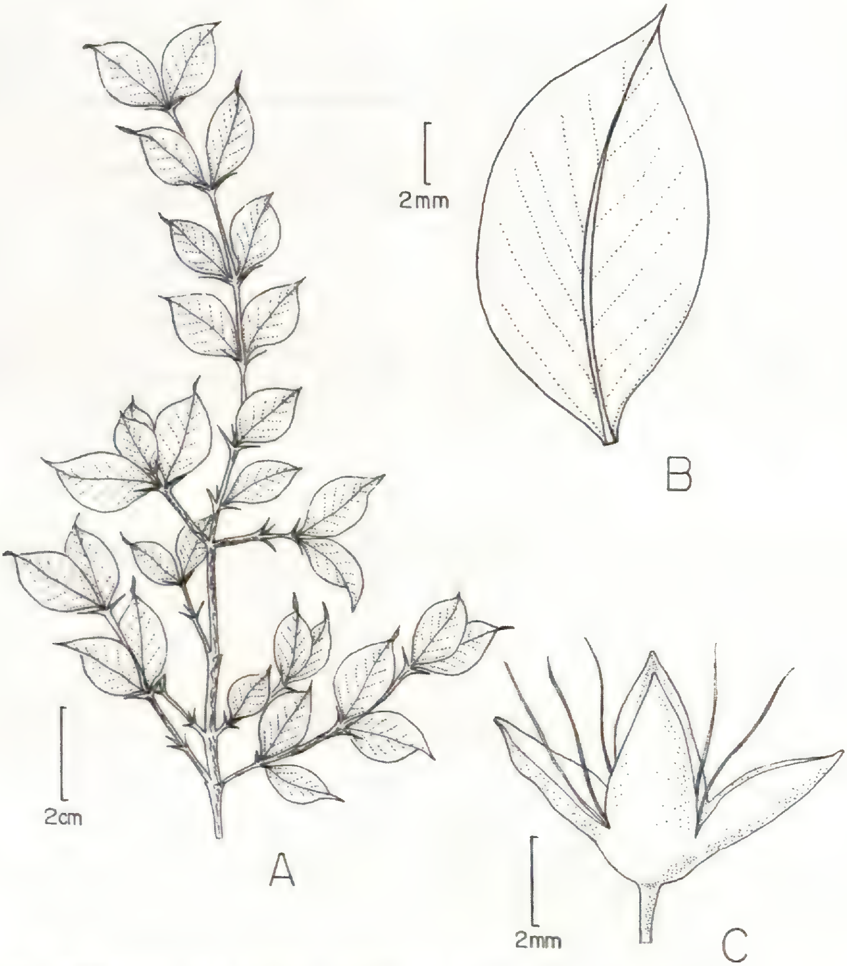

Figure 30. *Ginoria lanceolata* O. C. Schmidt. —A. Habit. —B. Leaf, abaxial view. —C. Flower. A–C from *Ekman 9696* (S).

of Chachalacas," 29 Mar. 1955, *L. I. Davis & E. B. Kincaid, Jr. 55-8* (holotype, TEX!; isotypes, GH!, MEXU!, SMU!).

Shrubs to tall trees, 5–40 m; stems glabrous; nodes unarmed. *Leaves* sessile or petioles to 2 mm; blades narrowly elliptic or lanceolate, 40–90 × 15–35 mm, membranous, glabrous, bright green adaxially, paler abaxially, base attenuate, apex acuminate to generally long-acuminate with acute tip, margin membranous, intramarginal vein present, 1.5–3 mm inside the margin at widest leaf diameter, secondary veins in 11 to 13 pairs, nearly horizontal, gradually arcuate, tertiary veins thin, obscure. *Inflorescences* 8- to 20-flowered brachyblasts 1–15 mm, umbelliform, rarely flowers also solitary in the axils of the main stem leaves; pedicels 4–10 mm, slender, mostly erect; bracteoles 0.8–1.5 mm, narrowly linear. *Flowers* 4-merous, obovoid in bud, shallowly campanulate at anthesis, membranous, 5–8 mm, 3–3.5 mm diam. at the floral cup margin, green or occasionally wine-red within, gradually contracted to a slender epipodium 1–3 mm; floral cup 2–2.5 mm, green; sepals 2–3 × 3–3.5 mm, narrowly deltate, erect to spreading at anthesis, ultimately strongly deflexed in fruit; epicalyx absent; petals 4, suborbicular to narrowly obovate, (4–)6.5–7 × 3–5 mm including a claw ca. 0.5 mm, pale pink to white; stamens 12 to 16 or 28 to 40, inserted 0.5–1 mm below the sinuses at the base of a freestanding collar ca. 0.5 mm wide, the collar formed by the expanded distal margin of the inner tissue layer, stamens exserted, filaments 4–6.5 mm, anthers ca. 1.5 mm; ovary 3(or 4)-locular, green, turning red with age; style 5.5–11 mm, exserted. *Capsule* subglobose to oblong, exserted 2–5 mm beyond the

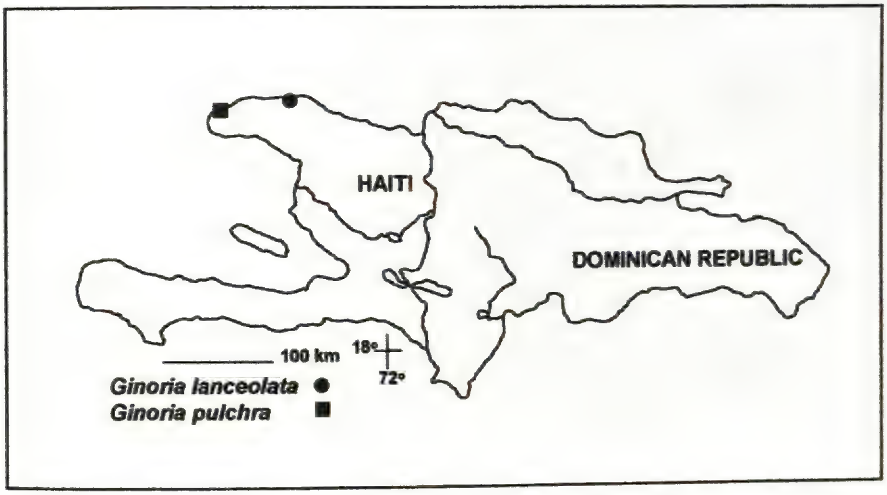

Figure 31. Distribution of *Ginoria lanceolata* O. C. Schmidt and *G. pulchra* (Ekman & O. C. Schmidt) S. A. Graham on Hispaniola.

deflexed lobes of the floral cup; seeds ca. 2 × 0.3–0.4 mm, fusiform, fragile. *Chromosome number*: $2n = 56$ (Graham & Cavalcanti, 2001).

Distribution. *Ginoria nudiflora* is endemic to Mexico, distributed in the states of Chiapas, Oaxaca, Veracruz, and Michoacán (Fig. 33). It inhabits primary and secondary subdeciduous forest slopes and gallery forests from tall evergreen forest to coastal lowland short forest. It occurs in deep sandy soils and on limestone at elevations of 24–2733 m.

Phenology. *Ginoria nudiflora* produces flowers primarily from March through June. Flowers begin to appear in the axils of last season's leaf scars before or with the appearance of the new season's leaves, and flowering continues as leaves expand. The capsular fruits, enclosed by the dry floral cup, are persistent on pedicels from April through November.

Common names. In Chiapas, pataté, a Tzeltal name from the area of El Real, ca. 60 km E of Ocosingo; in Oaxaca, agame; in Veracruz, guayabillo (Graham, 1991).

Discussion. *Ginoria nudiflora* is the only continental species of the genus. It is recognized by the long-acuminate leaves with a strong intramarginal vein, and by the dense umbelliform clusters of white-petaled flowers that appear just before or with the new season's leaves. In full flower, the trees attract great numbers of bees and other insects that visit for the abundant pollen (pers. obs.). Miranda (1952) described *G. nudiflora* as "one of the most beautiful trees in Chiapas, which has an abundance of beautiful trees." He found it to be the dominant tree in some places along the Río Santa Cruz, Chiapas. In Veracruz, it is common for miles in low coastal, semi-deciduous short forest. It is not known whether the presence of the species in western Mexico near coastal Michoacán is a natural disjunction or possibly the result of an early introduction from coastal Veracruz through shipping.

Ginoria davisii was described as a small tree with 12 to 16 stamens, whereas Koehne (1903) cited *G. nudiflora* as having 28 to 30 stamens. The type of *Antherylium nudiflorum* at Kew includes a sketch on which stamens are noted to be "sometimes nearly 40." Extensive collections of *G. nudiflora* now document the typical stamen number as 12 to 16, but with occasional increases in floral merosity and stamen proliferation, as happens in other *Ginoria* species. *Ginoria davisii* thus falls within the circumscription of *G. nudiflora*.

Additional specimens examined. MEXICO. **Chiapas:** Mpio. Chicoasén, 32 km N-NW of Soyalo along rd. to Copainala above Chicoasén, Mar. 1973, *Breedlove 34029* (MO, NY); Mpio. Ixtapa, along the Río Laja, 5 km N of Ixtapa, May 1973, *Breedlove 35078* (MO, TEX); betw. Ixtapa & Soyalo, Apr. 1981, *Breedlove 50647* (MO, NY, TEX); Mpio. Ixtapa, July 1981, *Breedlove 51661* (GH, MO); Km 59, carr. Huimanguillo–Mal Paso, *Gonzalez L. et al. s.n.* (MEXU); bank of the Río Laja, on the Ixtapa–Soyalo rd. NE of Tuxtla Gutiérrez, at 5 km N of Ixtapa, Apr. 1993, *Graham 1099* (MO); Mpio. Chicoasén, en el tunel del camino Tuxtla Gutiérrez–Chicoasén, Apr. 1987, *Martínez S. 20146* (MO); Santa Rita al Real, E of Ocosingo, *Miranda 7138* (MEXU); cerca de Banavil, al E de El Real, Mar. 1951, *Miranda 7184* (MEXU, US); N de Ixtapa, *Miranda 7494* (MEXU). **Michoacán:** Mpio. Aquila, 4 km camino Aquila–La Placita, *Guerrero C. 850* (ENCB); Coalcomán, Aquila, Mar. 1941, *Hinton 15808* (F, MICH, US); Atenquique, hacia del Camalote, 26 km al NE de El Ranchito, *Soto N. & Torres*

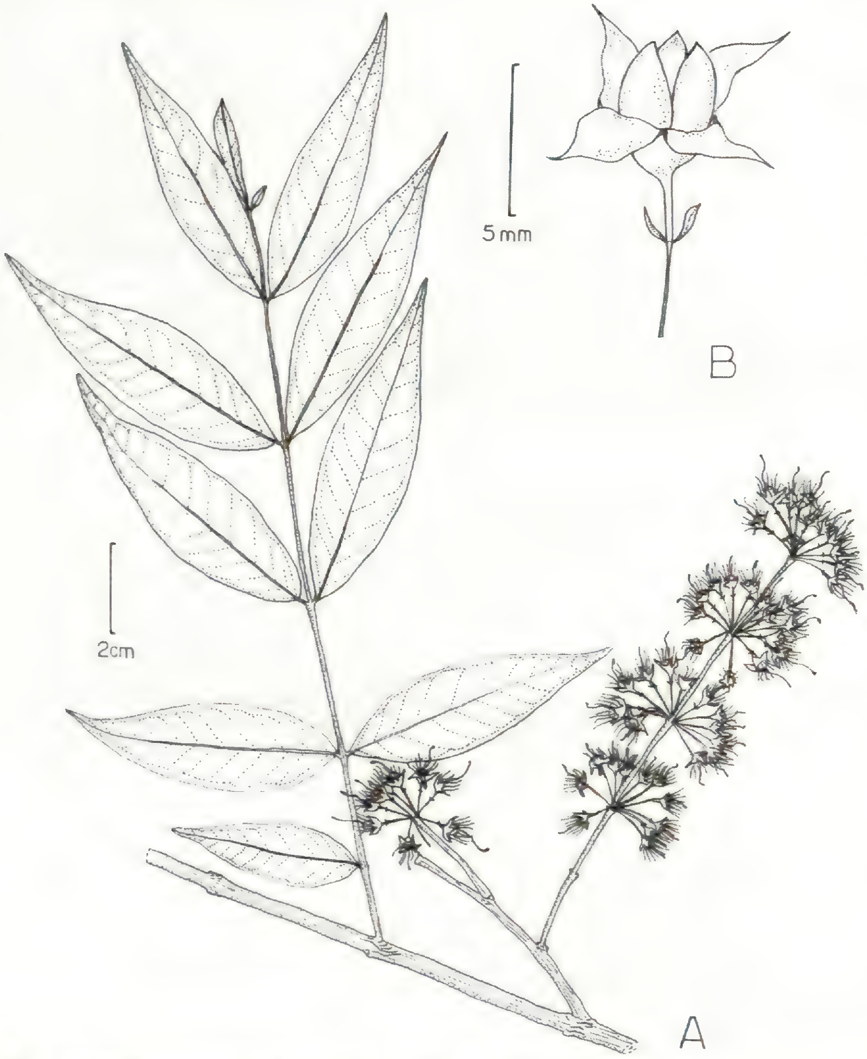

Figure 32. *Ginoria nudiflora* (Hemsl.) Koehne. —A. Habit. —B. Flower. A, B from *Soto N. & Torres C. 2849* (MO).

C. 2817 (MEXU, MO); en Aquila, Mar. 1981, *Soto N. & Torres C. 2849* (MO). **Oaxaca:** Mpio. Soyaltepec, Tuxtepec, a 4 km de Temazcal, camino al vertedor, *Cortes 264* (MO); Mpio. Soyaltepec, Tuxtepec, 3 km al S de la Hidroelectrica Temascal, *Cortes 867* (MO); Monte Mistaca[?], Mar. 1845, *Galeotti s.n.* (NY, US); Chiltepec, Tuxtepec, *Martínez C. 1336* (ENCB, MEXU, MO); Tuxtepec, *Raffauf & Giral s.n.* (ENCB); Valle Nacional, Mar. 1919, *Reko 4153* (US); Tuxtepec, a 3 km al S de Reforma, ya en el Mpio S. Ma. Jacatepec, carr. a Mano Márquez, June 1977, *Sousa 7281* (CHAPA, ENCB, MEXU, NY); a 19 km al W de Tuxtepec, carr. Tuxtepec–Huautla, Apr. 1977, *Tellez 405* (ENCB, MEXU, NY); Mpio. Cozolapa, 18 km al SO de Tezonapa, hacia Laguna Chica, Mar. 1986, *Torres C. 8154* (MO); Mpio. Matías Romero, 7.4 km al O de Esmeralda sobre terracería a Boca del Monte, luego 1.1 km al S por camino, Apr. 1981, *Wendt et al. 3203* (MEXU, MO, NY). **Veracruz:** Mpio. Actopan, alrededores de La Laguna de La Mancha, orilla de manglar, Nov. 1975, *Acosta/Dorantes A-640* (MO); detour to Chilapa, camino Playa Vicente a El Nigromante, *Chavelas et al. ES4201* (MEXU); Dos Ríos, Mar. 1930, *Mell 510* (NY, US); Montebellow, a orilla Papaloapan, *Miranda 4278* (MEXU); cerca y al S de Ciudad Alemán (O. de Papaloapan), Mar. 1956, *Miranda 8278* (US); orilla N de la Laguna de La Mancha, Apr. 1988, *Gutiérrez B. 3085, 3092, 3094* (MO); 1 km N de La Boca de Laguna de La Mancha, *Novelo 403* (MEXU, MO); Mpio. Veracruz, Neveria, carr. antigua nacional Xalapa–Tamarindo, Apr. 1988, *Gutiérrez B. 3101–3103* (MO); Actopan, Playa Paraiso, 2 km al NW de La Boca, de La Laguna de La Mancha, *Novelo 430* (MO); Ciudad Alemán, cerca de Tres Valles, *Paray 1922* (ENCB, MEXU); La Granja, selva de *Ginoria*, *Sousa 1739* (MEXU).

12. Ginoria pulchra (Ekman & O. C. Schmidt) S. A. Graham, comb. nov. Basionym: *Haitia pulchra*

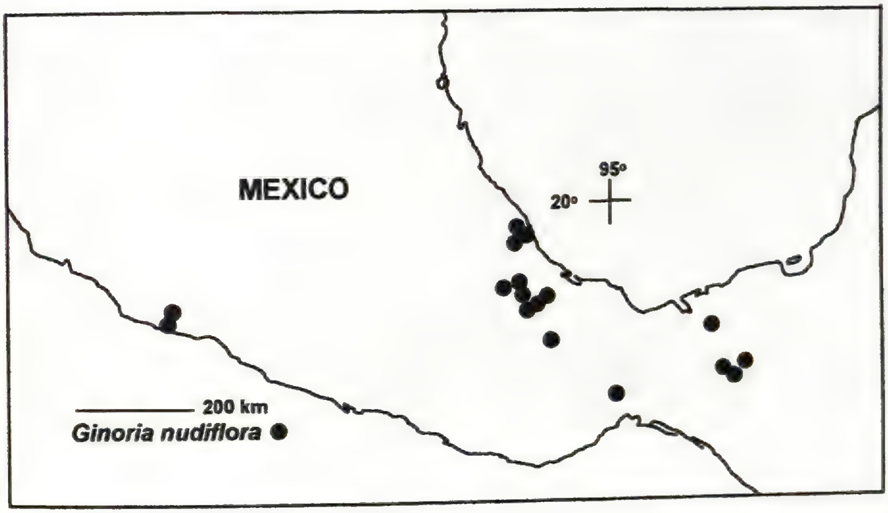

Figure 33. Distribution of *Ginoria nudiflora* (Hemsl.) Koehne.

Ekman & O. C. Schmidt, Ark. Bot. 21A(5): 18. 1927. TYPE: Haiti. "Peninsula septentr.-occid. in Môle St. Nicolas ad Baude Grande-Mer, in declivibus m. [3] Jul. 1925 flor.," *E. L. Ekman 4448* (holotype, S!; isotypes, EHH not seen, S!, US [2]!). Figure 34.

Shrubs 1–2.5 m tall; stems glabrous; nodes unarmed. *Leaves* with petioles 2–4 mm; blades suborbicular or broadly ovate, 17–52 × 10–40 mm, thickly coriaceous, yellow- to gray-green adaxially and abaxially, base rounded to shallowly acute, apex obtuse, frequently with a small mucro, margin thick, intramarginal vein present, ca. 1 mm inside the margin at widest leaf diameter, secondary veins in 3 to 6 pairs, shallowly ascending, secondary and tertiary veins thickened, coarsely reticulate, pale yellow. *Inflorescences* 1- to 3(to 5)-flowered highly reduced brachyblasts in the axils of the main stem leaves; pedicels 15–28 mm, sturdy, erect; bracteoles 1.4–1.7 mm, ovate-elliptic, coriaceous. *Flowers* 6-merous, subglobose in bud, shallowly campanulate at anthesis, coriaceous, 11–12 mm, 10 mm diam. at the floral cup margin, contracted below the ovary to a short, stout epipodium 1–2 mm; floral cup 6–7 mm, green; sepals 4–5 × ca. 5 mm, deltate, the lobes rolling outward, spreading to strongly deflexed in fruit, encircled on the inside of the floral cup by a raised ring of tissue; epicalyx a continuous, slightly undulating, thickened flange 1–2 mm wide, encircling the exterior of the floral cup at the base of the sepals; petals 6, obovate, ca. 14 × 11 mm, intense rose, violet-purple, or white with pinnate veins purple (*Leonard & Leonard 13168*); stamens 24 to 27, inserted 1.5–2 mm below the sinuses of the sepals on the distal edge of the narrowly free margin of the inner tissue layer, exserted, filaments 6–10 mm, anthers 2–2.5 mm; ovary 6-locular, slightly depressed, 6-sulcate, green; style 8–11 mm, exserted. *Capsule* included, reaching the margin of the floral cup; seeds 0.8–1 × ca. 0.3 mm, compressed, concave-convex, obovoid to oblong-elliptic.

Distribution. Endemic to Haiti, *Ginoria pulchra* is known only from the type area on the extreme northwestern coast (Fig. 31), growing on calcareous terraces and palisade cliffs above the sea in an arid, cactus desert–like zone at 100 m.

Phenology. The species flowers and fruits from February to July, with peak flowering probably in February and March.

Discussion. Ginoria pulchra is immediately distinguished from all other species of the genus by the thick, yellowish to gray-green, suborbicular leaves. It shares with *G. buchii* in Haiti and *G. glabra* in Cuba the combination of two distinctive and highly derived morphological features of the genus: an epicalyx encircling the exterior of the floral cup, and stamens 24 or more in number. *Ginoria pulchra* is a rare, critically endangered species due to the extensive destruction of natural vegetation in Haiti (Sergile & Woods, 2001). Zanoni, collecting in 1985 in the type area, found the plant growing from the side of a vertical cliff in an area otherwise decimated by charcoal makers. Hopefully, the species has survived there due to the near inaccessibility of the site. Ekman, in field notes on the holotype, wrote that the species was collected on the steep ascent of the

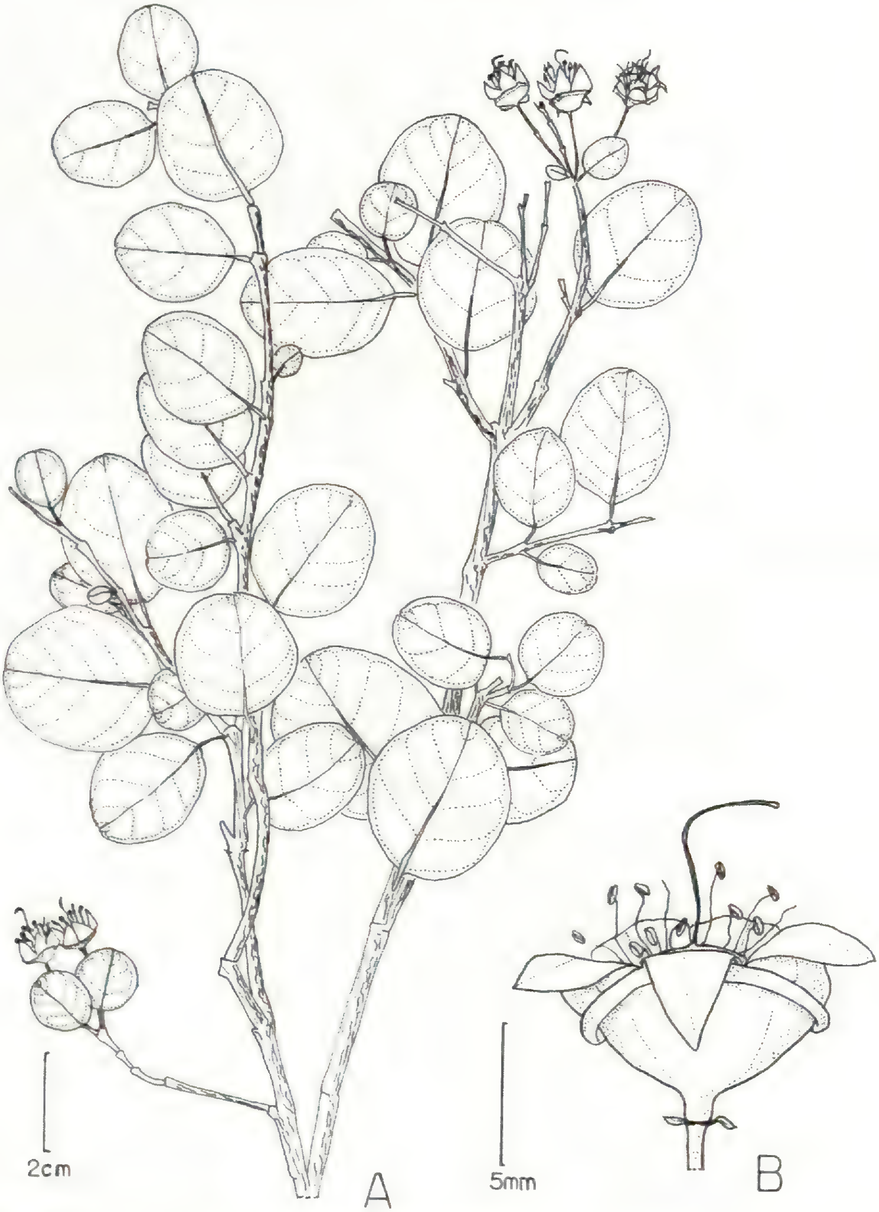

Figure 34. *Ginoria pulchra* (Ekman & O. C. Schmidt) S. A. Graham. —A. Habit. —B. Flower. A, B from *E. L. Ekman 4448* (S).

second terrace at Baude Grande-Mer and that it occurred at similar localities at Bap à Foux.

Additional specimens examined. HAITI. **Nord-Ouest:** Vic. of Môle St. Nicolas, arid plateau of Cap du Môle, Feb. 1929, *Leonard & Leonard 13168* (GH, NY, US [2]); Presqu'ile Nord-Ouest, 13.1 km al E de Môle St. Nicolas en la carretera costera a Jean-Rabel, Feb. 1985, *Zanoni et al. 33439* (GH, MO, S).

13. Ginoria rohrii (Vahl) Koehne, Bot. Jahrb. Syst. 3: 351. 1882. Basionym: *Antherylium rohrii* Vahl, Skr. Naturhist.-Selsk. 2: 211. t. 8. 1792. TYPE: Virgin Islands [U.S. Virgin Islands]. St. Croix: "HB Vahlii ex Insula St. Crucis, mis. Dr. von Rohr" (lectotype, designated by Graham, 2005: 298, C digital image!; isotype, C digital image!). Figures 1, 35.

Shrubs or small trees to 7 m, slender trunk to ca. 1 dm DBH; stems glabrous, young stems 4-angled or 4-winged; nodes armed by (2 to)4 spines 1–4 mm, the spines robust, incurved to erect. *Leaves* decussate, rarely ternate, with petioles 1–3 mm; blades broadly ovate-elliptic to obovate or oblong, 30–85 × 18–45 mm, coriaceous, glabrous and shining adaxially, paler abaxially, base acute, rarely rounded, apex obtuse, sometimes also slightly mucronate, margin membranous, intramarginal vein present, 1–3 mm inside the margin at widest leaf diameter, secondary veins in 8 to 11 pairs, sharply ascending, tertiary veins obscure. *Inflorescences* 2- to 8-flowered highly reduced brachyblasts, flowers also solitary in the axils of main stem leaves; pedicels 4–13 mm, slender, lax; bracteoles 0.2–5 mm, linear. *Flowers* 4-merous, subglobose in bud, shallowly campanulate at anthesis, thin, membranous, 6.5–7.5 mm, ca. 3 mm diam. at the floral cup margin, abruptly contracted below the ovary to a slender epipodium 0.5–2 mm; floral cup 1–1.5 mm, green; sepals 3.5–5 × 2.2–3 mm, narrowly deltate, erect to spreading; epicalyx absent, the margin of the sinuses sometimes slightly thickened; petals 4, obovate-orbicular, 7–7.5 × 4–4.5 mm including a claw 0–0.5 mm, slightly exceeding the sepals, white; stamens 12 to 16(to 20), inserted ca. 0.5 mm below the sinuses of the sepals along the distal margin of the inner tissue layer, exserted, filaments 9–13 mm, subequal, anthers ca. 2 mm; ovary 2- to 4-locular. *Capsules* oblong, reaching the apex of the sepals; seeds ca. 2.5 × 0.3 mm, narrowly fusiform, fragile. *Chromosome number*: $2n = 56$ (Graham & Cavalcanti, 2001).

Distribution. *Ginoria rohrii* is distributed in Puerto Rico, especially on the eastern and southern coasts of the island, on Vieques Island, and in the Virgin Islands on St. Croix, St. John, St. Thomas, Tortola, Guana Island, and Virgin Gorda (Fig. 36). In occurs in dry coastal forests and thickets, on rocky hillsides, on seasonally flooded ground, and in coastal sands from 0–60 m.

Phenology. *Ginoria rohrii* flowers from February to May, with the flowers appearing before the leaves. Flowers and fruits appear intermittently at other times, the old flowers and pedicels often being retained into the next season.

Common names. Rosa de ciénega, ucarillo, cereza; in Puerto Rico, serrazuela; in Tortola, sugar-ant (Little et al., 1974).

Discussion. This easternmost species of *Ginoria* is a spiny shrub or small tree primarily of upland, dry, spiny coastal thickets but is occasionally also found in brackish, flooded low woodlands. The unique combination of characters defining *G. rohrii* includes broadly elliptic to obovate leaves with a prominent intramarginal vein, two or four stout nodal spines, and 4-merous, deeply lobed flowers with white petals. The species was cited from Haiti by Mayerhoff and Eggers (Liogier, 1986), and as an introduction to St. Vincent (Koehne, 1882, citing Eggers as the source). I have not been able to verify these citations. A specimen of *G. rohrii* (*Eggers 3307*^{2}, US) labeled "Santo Domingo" is doubtfully from there; the collection number is crossed out on the label and the specimen is morphologically very similar to *Eggers 307* (GOET) from Puerto Rico. *Ginoria rohrii* has also been recorded from the Dominican Republic based on a misidentification (*Canela L. s.n.*, US) of the rare *G. jimenezii*. There is no sound evidence that *G. rohrii* was ever part of the flora of Hispaniola.

Additional specimens examined. PUERTO RICO. **Fajardo:** Bo. Cabezas, Cabezas de San Juan, Nature Reservoir Headland, Mar. 1994, *Axelrod 7608* (NY, UPRRP); saline soil near Salinas, Apr. 1933, *N. L. Britton & E. G. Britton 10123* (US), *10126* (NY); Aguirre, subsaline plain, Feb. 1922, *Britton et al. 6024* (NY); Playa de Fajardo, Mar. 1913, *Britton & Shafer 1562* (NY, US); Fajardo lighthouse, Apr. 1899, *Heller 1188* (NY, US); Fajardo, dry thickets near lighthouse, Oct. 1964, *Howard & Taylor 15717* (A, S); Cabeza de San Juan, NE end of Puerto Rico, Aug. 1954, *Little 16427* (NY, US); Sabana Grande, 10 Mar. 1935, *Sargent 202* (US); prope Salinas de Cabo-rojo in sylvis litoralibus, Feb. 1885, *Sintenis 541* (A, GH, GOET, US); Pt. Fajardo ad litora maris, Apr. 1885, *Sintenis 541b* (A); Fajardo, May 1885, *Sintenis 1595* (JE, MO, NY, S, US); prope Guanica in sylvis ad Lagunam, Feb. 1886, *Sintenis 3836* (GH, US); prope Naguabo in sylvis litoralis ad Guazacan, Nov. 1886, *Sintenis 5486* (GH, MO, NY, S, US); Naguabo in paludosis, *Stahl 74* (S); near the lighthouse at Las Croabas, July 1965, *Wagner 864* (A, CM), *Wagner 1407* (A, CM); Punta Fajardo, dryland thickets near the lighthouse, Mar. 1966, *Wagner 988* (CM, MO). **Vieques:** NW corner of island, dirt rd. betw. Kiani Lagoon and sea, July 1992, *Axelrod 4981* (UPRRP); s. loc., 1896, *Eggers s.n.* (MO); just NE of Laguna Kiani, Sep. 1983, *Proctor 39535, 48846, 49271* (MO); s. loc., Jan. 1914, *Shafer 2403* (NY, US); s. loc., *Woodbury s.n.* (MO). VIRGIN ISLANDS. **Guana Island:** Palm Ghut, Apr. 1987, *Proctor 43473* (NY). **St. John:** East End, mi. 12, 0.5 mi. before end of rd., Mar. 1985, *Acevedo R. et al. 682* (NY); Salt Palm Rd., 100 m from Moravian church, June 1985, *Acevedo R. et al. 732* (NY); East End Quarter, E of Southside Pond, Aug. 1987, *Acevedo R. et al. 1827* (NY); Cob Gut, Jan. 1990, *Acevedo R. 003221* (MO, NY, US); East End Quarter, Center Line Rd., Km 12, about 50 m from coastline, Aug. 1992, *Acevedo R. et al. 5137* (NY, US); Coral Bay, Apr. 1983, *Liogier 34243* (NY); coastal hills, July 1921, *Morrow 171* (US). **St. Thomas:** Water Island, *Britton et al. 131* (NY, US); Paradise Bay, *Britton & Britton 210* (NY); s. loc., 1886–87, *Eggers 52* (GH); Bolorigo, *Eggers 170* (GH, NY); in locis palud., prope ripam maris, Mar. 1887, *Eggers 307* (GOET, JE); Longbay near seashore, *Eggers s.n.* (MO); Soldier Bay strand, *Eggers s.n.* (MO); Cromboy, July 1881, *Eggers s.n.* (US); s. loc., Nov. 1880, *Eggers s.n.* (NY); Northeast Bay, coastal sands, May 1940, *Holdridge LRH-121* (A, NY, US); s. loc., Feb. 1906, *Raunkiaer s.n.* (S); San

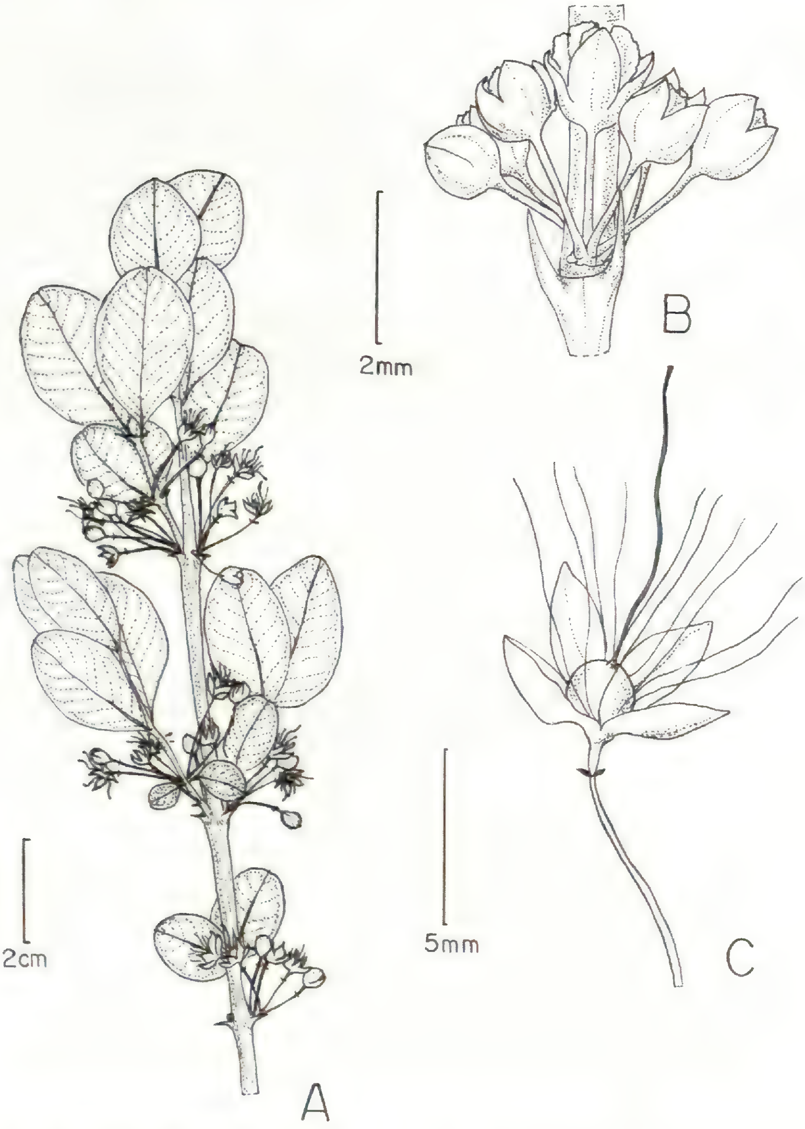

Figure 35. *Ginoria rohrii* (Vahl) Koehne. —A. Habit. —B. Axillary inflorescence and nodal spines. —C. Flowers. A–C from *Eggers 307* (JE).

[sic] Thomas, 1827, *Wyder 46* (NY). **Tortola:** Fish Bay to Road Town, *Britton & Shafer 906* (NY, US); Fort Hill (Baughen Bay), cliffside below main rd. overlooking sea, Apr. 1965, *D'Arcy 50A* (A), *50C* (MO); Frenchman's Cay by Soper's Hill, May 1965, *D'Arcy 182* (A), *182A* (MO); Baughen Bay, May 1919, *Fishlock 400* (GH, NY). **Virgin Gorda:** coastal hills, Little Dix Bay, *Fishlock 219* (NY); s. loc., Jan. 1919, *Fishlock s.n.* (US); s. loc., June 1969, *Little 23812* (NY, US); s. loc., *Woodbury s.n.* (MO). **Exact locality unknown:** S-Crucis et Porto-Rico, *Richard s.n.* (B-W digital image); *Dr. West s.n.* (C [Hb. Vahlii] digital image).

Excluded Names

Antherylium floribundum (Kunth) Spreng., Syst. Veg. 2: 475. 1825. = *Adenaria floribunda* Kunth.

Antherylium grisleoides (Kunth) Spreng., Syst. Veg. 2: 475. 1825. = *Adenaria floribunda* Kunth.

Antherylium purpuratum (Kunth) Spreng., Syst. Veg. 2: 475. 1825. = *Adenaria floribunda* Kunth.

Ginora L., Sp. Pl. ed. 2. 642. 1762 [and numerous subsequent authors].

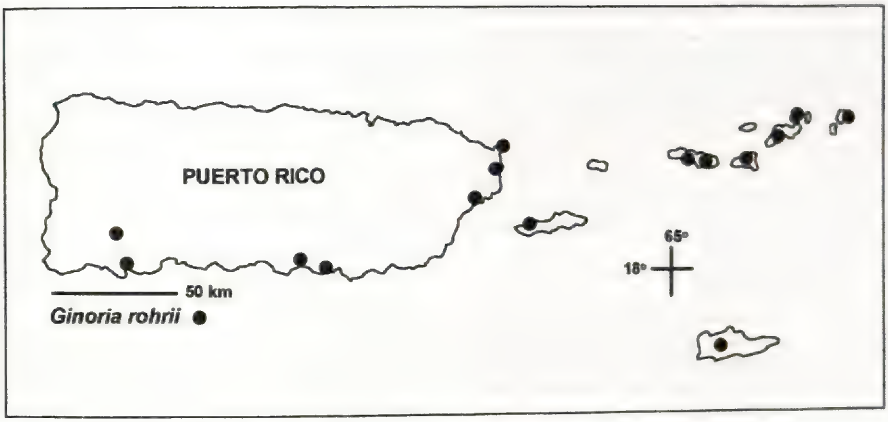

Figure 36. Distribution of *Ginoria rohrii* (Vahl) Koehne in Puerto Rico and the Virgin Islands.

Orthographic variants exist for *Ginoria*. Index Kewensis 2.0 lists a number of species employing the orthographic variant: *Ginora americana* L., *Ginora curvispina* Koehne, *Ginora diplusodon* Koehne, *Ginora glabra* Griseb., *Ginora nudiflora* Koehne, *Ginora rohrii* Koehne, and *Ginora spinosa* Griseb. The names attributed to Koehne (Bot. Jahrb. Syst. 3: 349–351) and Grisebach (Cat. Pl. Cubens. 106) are not present in those publications.

Ginoria americana Griseb., non Jacq. in Koehne, Pflanzenr. (Engler) IV. 216: 249. 1903.

Ginoria americana Griseb. is a misidentification for *G. spinosa* Griseb. and *G. curvispina* Koehne.

Ginoria Sesse & Moç. ex DC., Prodr. 3: 89. 1828. Pro syn. = *Heimia* Link.

Ginoria flava Sesse & Moç. ex DC., Prodr. 3: 89. 1828. Pro syn. = *Heimia salicifolia* Link.

Ginoria syphilitica Sesse & Moç. ex DC., Prodr. 3: 89. 1828. Pro syn. = *Heimia salicifolia* Link.

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APPENDIX 1. Classification of *Ginoria* by Koehne (1903). Names in brackets are currently accepted names following this revision.

Subgenus *Euginoria* Koehne [subgenus *Ginoria*]: Flowers typically 6-merous

Section *Prismatospermum* Koehne [section *Ginoria*]: Seeds obovoid-prismatic, stamens (10)12 to 16; *G. americana*, *G. spinosa* [= *G. americana* var. *spinosa*]

Section *Discospermum* Koehne: Seeds complanate; stamens 18 to 23; *G. curvispina*, *G. diplusodon* [= *G. ginorioides*], *G. glabra*

Subgenus *Antherylium* (Rohr & Vahl) Koehne: Flowers typically 4-merous; *G. nudiflora*, *G. rohrii*

APPENDIX 2. Numbered collections studied. Numbers in parentheses correspond to the number of the species in the text and in the List of Species below. Collection numbers in boldface indicate type numbers.

LIST OF SPECIES

1. *Ginoria americana* Jacq.
  1a. var. *americana*
  1b. var. *spinosa* (Griseb.) S. A. Graham
2. *Ginoria arborea* Britton
3. *Ginoria buchii* (Urb.) S. A. Graham
4. *Ginoria callosa* O. C. Schmidt
5. *Ginoria curvispina* Koehne
6. *Ginoria ginorioides* (Griseb.) Britton
7. *Ginoria glabra* Griseb.
8. *Ginoria jimenezii* Alain
9. *Ginoria koehneana* Urb.
10. *Ginoria lanceolata* O. C. Schmidt
11. *Ginoria nudiflora* (Hemsl.) Koehne
12. *Ginoria pulchra* (Ekman & O. C. Schmidt) S. A. Graham
13. *Ginoria rohrii* (Vahl) Koehne

Acevedo-Rodríguez, P. 5488 (1a); *Acevedo-Rodríguez, P. et al. 1827* (13), *3221* (13), *5137* (13); *Acosta/Dorantes A-640* (11); *Acuña, J. 5172* (5), *5173* (5), *10573* (1a), *10760* (1a), *17144* (5), *19038* (1a), *24165* (1a), *24168* (1a); *Acuña, J. & Rodríguez, E. 16299* (5); *Acuña et al. 16182* (9); *Alain, Bro. 1737* (1a), *3965* (6), *6700* (6), *8997* (9), *15819* (9), ***16182* (9)**, *24167* (1a); *Alain, Bro. & Acuña, J. 1203* (9); *Alfonso, O. et al. 153* (6), *186* (1b); *Alvarez de Zayas, A. et al. 28787* (6), *33466* (1a), *41947* (6), *43136* (2), *43778* (5), *43791* (5); *Areces, A. 2136* (1a); *Areces, A. et al. 25176* (1a), *29964* (2), *31375* (2), *31478* (5), *31753* (5), *45158* (6); *Arias, I. et al. 61566* (5), *62072* (1a); *Avila, J. et al. 3028* (1a), *3045* (5); *Axelrod, F. 4981* (13), *7608* (13), *10318A* (1a).

Baker 2797 (1a); *Baker & Donovan 4143* (1a); *Barreto, A. et al. 884* (5); *Bécquer, E. 303* (6), *755* (1a), *781* (1a); *Bécquer, E. et al. 6661* (6); *Berazaín, R. 23150* (1a); *Berazaín, R. & Areces, A. 24889* (6); *Berazaín, R. & González, S. 31967* (1a), *31973* (1a), *31974* (1a), *31979* (1a); *Bisse J. 645* (1a), *5006* (1b), *7727* (2), *8053* (6), *9796* (1a), *10681* (1a), *10183* (2), *13173* (6), *14570* (2), *17523* (1b), *18331* (1a), *21769* (2), *21830* (2), *23253* (6); *Bisse, J. & Duek, J. 1114* (1a); *Bisse, J. & Köhler, E. 8053* (6); *Bisse, J. & Lippold, H. 13175* (6), *18508* (1a), *19501* (1a); *Bisse, J. & Rojas, L. 4706* (1a); *Bisse, J. et al. 21091* (5), *30919* (6), *33974* (2), *35183* (1b), *36577* (2), *38193* (9), *39076* (2), *39305* (2), *39471* (2), *39689* (1a), *41140* (1a), *44904* (1a); *Bonet, W. 7454* (1a); *Borhidi, A. et al. 114/3* (1a); *Breedlove, D. E. 34029* (11), *35078* (11), *50647* (11), *51661* (11); *Britton, N. L. et al. 131* (13), *446* (6), ***2217* (2)**, *2368* (5), *5560* (6), *5577* (6), *5858* (6), *5900* (6), *5903* (6), *6024* (13), *6083* (6), *6093* (1b), *6742* (1a), *12953* (1a), *13113* (5), ***13148* (5)**; *Britton, N. L. & E. G. Britton 210* (13), *10123* (13), *10126* (13); *Britton, N. L. & Cowell 10188* (6); *Britton, N. L. & J. A. Shafer 906* (13), *1562* (13); *Britton, N. L. & P. Wilson 5474* (6); *Brull, G. C. and R. Verdecia 5432* (9); *Buch, W.* ***1181* (3)**; *Bucher, G. 223* (6).

Calzada, R. P. et al. 6153 (1a); *Camacho, M. et al. 691* (1a); *Cañizares, L. et al. 99* (1a); *Castellanos 97* (1a); *Castañeda, I. 6913* (5); *Castañeda, I. & N. Vera 6837* (6); *Chavelas, J. et al. ES4201* (11); *Clemente, Bro. 2410* (1a), *4872* (7), *6312* (1a); *Clemente, Bro. & Bartolomé, Bro. 5924* (1a); *Clemente, Bro. & Chrysogone, Bro. 3410* (1a); *Colaboradores del Flora de Cuba 62522* (9); *Combs, R. 26* (1a); *Cortes, L. 264* (11), *867* (11); *Curbelo, M. 206* (9), *229* (9), *24166* (9).

D'Arcy, W. G. 50A (13), *50C* (13), *182* (13), *182A* (13); *Davis, L. I. & E. B. Kincaid, Jr.* ***55-8* (11)**; *Duarte, V. 7007* (1a).

Eggers, H. 52 (13), *107* (13), *170* (13), *307* (13), *4583* (1a); *Ekman, E. L. 83* (1a), *2790* (1a), *4317* (1a), ***4448* (12)**, ***4575* (10)**, ***4619* (4)**, *5676* (3), ***6356* (9)**, ***7325* (5)**, *7428* (9), *8363* (2), *8579* (1a), *9696* (10), *10221* (1a), *10871* (6), *11549* (5), *13742* (6), *14051* (1b), *14052* (6), *14614* (7), *15524* (5), *15780* (2), *16405* (6), *16517* (1b), *17006* (5), *17406* (9), *18608* (1a), *18824* (6), *18919* (6), *18966* (6), *18973* (6), *19049* (5); *Expedición del HAC 37366* (1a), *37332* (1a).

Fernando, Bro. 114 (1a), *369* (1a); *Figueiras, M. L. 521* (1a), *1566* (1a), *2444* (7), *2918* (5); *Fishlock, W. 219* (13), *400* (13); *Fors, A. J. 4367* (1a).

Garcia, R. & Jiménez, F. 3614 (8); *Garcia, R. & Pimentel, H. 7411* (8); *Gillis, W. T. 7983* (1a); *Glassman & Acuña 20709* (1b); *Gonzales, A. 655* (6); *Graham, S. A. 1099* (11), *1135* (1b), *1136* (6), *1137* (1a), *1139* (5), *1140* (5), *1142* (9), *1143* (5), *1144* (6), *1145* (1a); *Grouddzinskaya, I. 29196* (1a); *Guerrero C., G. 850* (11); *Gutiérrez B., C. 3085* (11), *3092* (11), *3094* (11), *3101* (11), *3102* (11), *3103* (11).

Harvard Course in Tropical Botany 121 (1b), *875* (1b); *Heller, A. A. 1188* (13); *Herrera, P. 2996* (5); *Hinton, G. Hioram, Bro. 1511* (1a); *Holdridge, L. R. LRH-15808* (11); *121* (13); *Hoss 4787* (5); *Howard, R. A. 121* (1b), *122* (6), *5063* (1b), *6245* (1a); *Howard, R. A. & Taylor, G. 15717* (13); *Hodge, W. H. & Howard, R. A. 4146* (1a), *4561* (1a); *Hunnewell, F. W. 11548* (1a), *11577* (6).

Jack, J. G. 4070 (1a), *4532* (1a), *4731* (1a), *5082* (1a), *5481* (1a), *5551* (1a), *5967* (6), *5969* (6), *6779* (1a), *7028* (6), *7899* (6), *7970* (6); *Jiménez, F.* ***2684* (8)**; *Jurgensen, C.* ***956* (11)**.

Lago 24169 (1a); *Lazo, R. 24169* (1a); *León, Bro. 331* (1a), *486* (1a), *3421* (1a), ***11009* (7)**, *11768* (7), *15631* (1a), *16076* (6), *16480* (5), *17229* (7), *18571* (7); *León, Bro. & Alcine, Bro. 5029* (6), *5200* (6); *León, Bro. & Marie-Victorin, Bro. 17649* (5); *Leonard, E. C. & Leonard, G. M. 13168* (12); *Liogier, A. 14693* (3); *Lippold, H. et al. 26187* (6); *Little, E. 16427* (13), *23812* (13); *Luis, M. et al. 3804* (1a).

Manitz, H. et al. 60393 (5); *Marie-Victorin, Bro. 60047* (1a); *Martínez C., G. 1336* (11); *Martínez S., E. 20146* (11); *Martínez V. & Trujillo, R. 9020* (6); *Matos, J. et al. 590* (6), *1725* (6); *Matos, P. 18571* (7); *Mell, D. 510* (11); *Méndez, E. 3302* (9), *3368* (1a); *Méndez, E. & Avila, J. 7385* (5), *7386* (5); *Méndez, E. & Elenevsky, A. G. 8036* (1b); *Méndez, E. & Trujillo, R. 3557* (5); *Méndez, E. & Verdecia, R. 992* (6), *1013* (6), *1074* (1a), *4514* (1a), *4641* (5), *4718* (6), *4843* (6); *Méndez, E. et al. 1858* (5), *4069* (5), *10019* (1b); *Meyer, K. 28266* (1a); *Miranda, F. 7138* (11), *7184* (11), *7494* (11), *8278* (11); *Misión de Fitoquimicos 27081* (1b); *Morales, S. A. 375* (5), *473* (1a), *474* (1a), *475* (5), *495* (5); *Morrow, C. F. 171* (13); *Morton, C. V. 3975* (1a), *4402* (1a), *10380* (1a); *Morton, C. V. & Acuña, J. 3847* (1a).

Noa, A. 4095 (6); *Noa, A. & I. Castañeda 153* (1a), *3933* (6); *Noa, A. & Méndez, E. 7373* (1b); *Noa, A. et al. 306* (1b), *427* (6), *470* (1b), *560* (6), *562* (1b), *623* (6), *1453* (6), *3843* (6), *6409* (1a); *Novelo, A. 403* (11), *430* (11).

Olviedo, R. 3149 (9), *42322* (5).

Paray, L. 1922 (11); *Pérez, A. 243* (1a), *244* (6), *790* (5), *791* (5), *792* (5), *793* (5); *Pérez, E. et al. 3809* (5); *Pollard, L. et al. 39* (1a); *Ponce, R. 229* (1a); *Pringle, C. G. 105* (1a); *Proctor, G. R. 39535* (13), *48846* (13), *49271* (13).

Rehder, A. 1123 (1a), *1165* (6); *Reko, B. P. 4153* (11); *Risco, R. & Caballero, R. 6278* (5); *Risco, R. & Méndez, E. 2544* (1a); *Risco, R. & Romano, R. 9516* (1a); *Roig y Mesa, J. T. 3249* (6), *5172* (5), *8548* (6), *11069* (7); *Roig & Luaces 825a* (5); *Roig et al. 5999* (5), *6092* (6); *Rugel, F. 65* (1a), *727* (1a).

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APPENDIX 3. Distribution of *Ginoria* species by country.

Mexico: *G. nudiflora*
Cuba: *G. americana*, *G. arborea*, *G. curvispina*, *G. ginorioides*, *G. glabra*, *G. koehneana*
Hispaniola: Haiti: *G. buchii*, *G. callosa*, *G. lanceolata*, *G. pulchra*. Dominican Republic: *G. buchii*, *G. jimenezii*
Puerto Rico and the Virgin Islands: *G. rohrii*

APPENDIX 4. Character list for morphological matrix.

1. **Tertiary leaf venation:** 0 = thin, brown or scarcely visible; 1 = thickened, yellowish, forming raised areolae.
2. **Spines:** 0 = absent; 1 = present.
3. **Inflorescence:** 0 = ending in a vegetative bud (blastotelic or polytelic); 1 = ending in a flower (anthotelic or monotelic).
4. **Floral merosity:** 0 = 4; 1 = 6; 2 = 5.
5. **Floral cup length:sepal length:** 0 = 0.2–0.5 (floral cup shorter and sepals longer); 1 = 0.7–1 (floral cup and sepals approximately equal length); 2 = 1.2 or greater (floral cup longer and sepals shorter).
6. **Epicalyx:** 0 = absent; 1 = individual epicalyx segments at the sinus of the sepals; 2 = a continuous encircling flange.
7. **Petal color:** 0 = white or pale pink; 1 = rose to purple; 2 = petals absent.
8. **Inner floral cup tissue:** 0 = not free at distal margin; 1 = narrowly free at distal margin; 2 = the margin expanded as a freestanding collar.
9. **Lowest stamen number:** 0 = 8 or less; 1 = 12 to 18; 2 = 24 or more.
10. **Pollen pseudocolpi:** 0 = absent; 1 = present.
11. **Pollen exine:** 0 = scabrate; 1 = verrucate; 2 = psilate; 3 = striate.
12. **Fruits:** 0 = dehiscent; 1 = indehiscent.
13. **Seeds:** 0 = compressed, obovoid, subrectangular, or fusiform; 1 = not compressed, obpyramidal.
14. **Seed mesotesta:** 0 = multilayered; 1 = homogenous, nonlayered.

APPENDIX 5. Morphological matrix for cladistic analysis.

Outgroup	
Ammannia	00002 aa001 3100
Crenea	00001 00001 1100
Decodon	00020 11000 b011
Lagerstroemia	00111 0a001 a011
Lawsonia	00101 00001 2111
Tetrataxis	00001 02000 2000
Ingroup	
Ginoria americana	0a011 01011 0000
G. arborea	01000 00011 0000
G. buchii	00011 21121 0000
G. callosa	10012 11121 0000
G. curvispina	01011 11011 0000
G. ginorioides	00011 11011 0000
G. glabra	10011 21121 0000
G. jimenezii	00001 01011 0000
G. koehneana	01000 00011 0000
G. lanceolata	01000 0?001 0000
G. nudiflora	00001 00211 0000
G. pulchra	10012 21121 0000
G. rohrii	01000 00011 0000

a = 0 and 1; b = 0 and 2.